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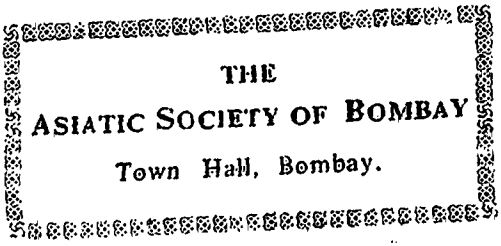

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SELECTIONS

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SELECTIONS FROM REPORTS

OF THE

TRIGONOMETRICAL, TOPOGRAPHICAL

AND

REVENUE SURVEYS

FOR THE YEAR

1867-68.

(With Map.)

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CONTENTS.

Page.

I.—TRIGONOMETRICAL SURVEY—

EXPLORATIONS OF TRANS-HIMALAYAN REGIONS 1

OBSERVATIONS OF THE TOTAL ECLIPSE OF THE SUN 2

THE PENDULUM OBSERVATIONS 6

MAGNETIC OBSERVATIONS 7

SURVEY OPERATIONS IN CONNECTION WITH THE ABYSSINIAN EXPEDITION 9

EXTRACTS FROM THE REPORTS ON THE TOTAL ECLIPSE OF 18TH AUGUST 1868 13

EXTRACT FROM THE NARRATIVE REPORT OF CAPTAIN J. P. BASEVI, R.E., SURVEYOR, 1ST GRADE, IN CHARGE NO. 4 EXTRA PARTY, NO. 58, DATED 10TH AUGUST 1868 26

NARRATIVE REPORT OF THE TRANS-HIMALAYAN EXPLORATIONS MADE DURING 1867, DRAWN UP BY CAPTAIN T. G. MONTGOMERIE, R. E., OF THE GREAT TRIGONOMETRICAL SURVEY FROM THE ORIGINAL JOURNALS, &C., OF THE TRANS-HIMALAYAN EXPLORING PARTIES 33

II.—TOPOGRAPHICAL SURVEY—

MEMORANDA ON THE FORT OF BANDOGURH, BY LIEUTENANT R. V. RIDDELL, R. E., IN CHARGE NO. 5 TOPOGRAPHICAL PARTY, REWAH AND BUNDELCUND SURVEY 66

MEMORANDUM AS TO GEOLOGY OF JAINTIA HILLS AND AS TO THE DISTRIBUTION OF TRIBES 69

III.—REVENUE SURVEY—

DESCRIPTION OF COUNTRY SURVEYED IN DISTRICT BURAICH, SEASON 1867-68, BY CAPTAIN A. D. VANRENEN, REVENUE SURVEYOR, 2ND DIVISION, OUDE 73

DESCRIPTION OF COUNTRY SURVEYED IN DISTRICT SEONEE, SEASON 1867-68, BY CAPTAIN R. E. OAKES, REVENUE SURVEYOR, 1ST DIVISION, CENTRAL PROVINCES 79

DESCRIPTION OF COUNTRY SURVEYED IN DISTRICT RAEPORE, SEASON 1867-68, BY R. B. SMART, ESQ., REVENUE SURVEYOR, 2ND DIVISION, CENTRAL PROVINCES 84

DESCRIPTION OF COUNTRY SURVEYED IN DISTRICT CHANDA, SEASON 1867-68, BY LIEUTENANT F. CODDINGTON, REVENUE SURVEYOR, 4TH DIVISION, CENTRAL PROVINCES 99

DESCRIPTION OF COUNTRY SURVEYED IN DISTRICT KAMROOP, SEASON 1867-68, BY LIEUTENANT A. D. BUTTER, ASSISTANT REVENUE SURVEYOR IN CHARGE 1ST DIVISION, LOWER PROVINCES 104

DESCRIPTION OF COUNTRY SURVEYED IN DISTRICT GOWALPARA, SEASON 1867-68, BY J. H. O'DONEL, ESQ., REVENUE SURVEYOR, 5TH DIVISION, LOWER PROVINCES 108

DESCRIPTION OF COUNTRY SURVEYED IN DISTRICT LOHARDUGGA, SEASON 1867-68, BY CAPTAIN J. SCONCE, REVENUE SURVEYOR, 6TH DIVISION, LOWER PROVINCES 116

SELECTIONS FROM REPORTS

OF THE

TRIGONOMETRICAL, TOPOGRAPHICAL AND REVENUE SURVEYS

FOR THE YEAR

1867-68.

I.—TRIGONOMETRICAL SURVEY.

EXPLORATIONS OF TRANS-HIMALAYAN REGIONS.

(41). The Trans-Himalayan explorations, under the direction of Captain Montgomerie, have, during the last year, been extended across the upper basins of the Sutlej and the Indus to some distance beyond the eastern watersheds, thus penetrating into that portion of Great Thibet which lies between the desert of Gobi and the upper basin of the Brahmaputra river. For this purpose a third Pundit was added to the explorers and trained to the work by Captain Montgomerie. The operations have been successfully carried out, and the results will be found fully detailed in Captain Montgomerie's report.

(42). The route-surveys extend over a total distance of 850 miles, in the course of which the latitudes of 75 different places were determined, and the heights of 80 places were deduced by the boiling point. By these route-surveys the geography of about 20,000 square miles of Thibet has been roughly determined, a considerable portion of which is entirely new, and the remainder having hitherto depended on a very narrow basis of route-survey. The course of the Sutlej between Shipki and Totling, hitherto unknown, has been roughly determined. The upper course of the river Indus has been traced south from the point where it leaves the Ladak territory nearly to its source. It has been definitely ascertained that there is a great eastern branch of the Upper Indus, and that the said branch, known to the natives as the Singh-gi-chû, is the main stream of the Indus, the branch on which Gartok stands being smaller and having a shorter course and being always called the Gartung-chû. Both these branches have had a route-survey carried along them; the portion between Gartok and Ladak, though indicated on all maps, has never been surveyed in any way, whilst the existence of the great eastern branch has been denied by many geographers.

(43). The explorations extend up to the western gold fields of great Thibet, the Thok Jalung field, the largest that is worked at present, having

been visited by the Pundits. Thok Jalung lies on the northern route from Rudok to Lhassa, and I hope that explorations may ultimately be extended from it along the slopes of the northern watershed of the Brahmaputra, and that the position and size of some of the great lakes known to exist in that direction may be thereby determined.

(44). These route-surveys have satisfactorily stood similar tests to those applied to the previous ones and described in para. 46 of my last report; the values of the pace, as derived from the differences of latitude, have been throughout found to be very accordant. A further conclusive test has also been forthcoming, as the routes start from and close on points which had been previously fixed in the course of the regular operations of the survey. The longitude of the terminal point, as derived from the route-survey, only differs from the Great Trigonometrical Survey value of the same by about 4 miles. This, and other comparisons, with points which have been accurately fixed, show that the work, rough though it be, is thoroughly reliable within narrow limits.

(45). Great credit is due to the Pundits for the way in which they carried out their work; for upwards of three months they were at an elevation of more than 12,000 feet above the sea, they crossed and re-crossed the Himalayan range three times, the Gangri range between the Sutlej and Indus three times, another very lofty range between the two upper branches of the Indus once, and that between the Indus and Thok Jalung twice; each of the crossings involving the ascent of a pass more than 17,000 feet above the sea, the highest being 19,500 feet.

(46). A map showing the geographical results accompanies this report, from which it will be seen that a very small portion of the upper basins of the Sutlej and Indus has been left untouched, and that the margin of the vast *terra incognita*, between the desert of Gobi and Lhassa, has been penetrated. I am not without hope that a considerable portion of this region may ultimately be explored.

OBSERVATIONS OF THE TOTAL ECLIPSE OF THE SUN.

(57). The year 1868 has been signalized by the occurrence of a total solar eclipse, which had long been looked forward to with peculiar interest, not only because it would be the first opportunity of applying the modern discovery of spectral analysis to investigate the physical nature of the corona around the sun's photosphere, and the red flames which appear to issue forth from the photosphere when the sun is totally eclipsed, but also because the period of totality would be of almost the greatest possible duration, and would afford more leisure than usual for such observations as can only be made during an interval which, at its longest, is but very brief, not more than 6 to 7 minutes. On the recommendation of the Royal Astronomical Society, Major Tennant was deputed by Government to make observations of the eclipse, and was supplied with all the instruments necessary for the purpose, including a spectroscope, polariscope, and photographic apparatus. Moreover the Royal Society, anxious to make the most of the opportunity and increase the chances of success by multiplying the number of observers, offered to place certain instruments at my disposal to be used by Officers of the

Trigonometrical Survey at different places along the central line of the eclipse. I readily accepted this offer, in anticipation of the sanction of Government, which was subsequently most cordially conceded, with an intimation that the Government "was prepared to do everything in its power towards securing full and accurate observations on this rare and important occasion."

(58). As none of the officers of this department had ever had an opportunity of acquiring a practical familiarity with the manipulation of spectroscopes and polariscopes, it was fortunate that when I received the proposals of the Royal Society, one of our officers, Lieutenant John Herschel, R. E., was in England, on leave of absence. He placed himself in communication with the Society, and had an opportunity of studying the subject of spectral analysis in the Observatory of Mr. Huggins, whose name is so well known in connection with this most interesting branch of physical science. I determined therefore to entrust him with the duty of carrying out the programme of operations proposed by the Royal Society. While in England he interested himself in the preparation of the instruments, and on his return to India, brought them out with him. They comprised—*first*, an equatorially mounted clock-driven telescope, of 62 inches focal length and 5 inches aperture, with a spectroscope having a single flint glass prism, and a micrometer screw for measuring the position of any lines observed; *second*, four portable hand-spectroscopes; *third*, a telescope mounted altazimuthally, and furnished with a double image prism and a Savart's polariscope, for the purpose of analyzing the light of the "corona" and "red flames" for polarization.

(59). Lieutenant Herschel was to use the equatorial instrument, and he prepared himself for the purpose by examining the spectra of the principal Southern Nebulæ, the Royal Society having suggested that these observations would not only enable the observer to acquire the necessary familiarity with the instrument, but "would be of very great value in the present state of our knowledge, and would certainly repay the entire cost of the instrument, should bad weather, or some unforeseen accident, render the primary object, the investigation of the sun, impossible." Lieutenant Herschel's observations of the Southern Nebulæ have been published from time to time in the proceedings of the Royal Society. The polariscope was allotted to Lieutenant Campbell, and one of the hand spectroscopes to Captain Haig, the rest being lent to persons who do not appear to have had an opportunity of using them. Captain Branfill was attached to Major Tennant's expedition, where he made the observations for polarization.

PERSONNEL.
Lieutenant J. Herschel, R. E.
Captain C. T. Haig, R. E.
Captain B. R. Branfill.
Lieutenant W. N. Campbell, R. E.

(60). The eclipse would occur towards the close of the rainy season, in the districts under the path of the total phase across the Peninsula of India. At such a time favorable weather could not be expected; on the contrary there was much reason to fear that clouds would be so prevalent as to conceal the eclipse from view. It was necessary therefore to make minute enquiries regarding the localities along the central line which offered the greatest advantages in point of climate, and the best promise of an unclouded sky. For this purpose a circular was prepared calling for information on the weather to be expected, the average rainfall in the three first weeks of August in preceding years, and other

matters, the knowlege of which might influence the selection or rejection of any particular locality. As the path of totality would cross portions of the Madras and Bombay Presidencies, and of the Nizam's Dominions, copies of the circular were sent to the Governments of Madras and Bombay, and to the Resident at the Court of the Nizam, to be transmitted to the several officers in charge of districts, and to all persons who might be able to contribute the necessary information. Enquiries were also made regarding the weather prospects in the province of Tenasserim, on the east coast of the Bay of Bengal, where the duration of totality would be greatest, and the sun nearly in the zenith.

(61). From the answers to these enquiries it appeared that very unfavorable weather might be expected at Tenasserim and on the Bombay Coast Line, that the most promising localities lay in the belt of country between the Madras Coast and the Western Ghâts, and further that in the neighbourhood of Jamkundi (lat. 16° 30′, long. 75° 22′) and Beejapore (lat. 16° 50′, long. 75° 48′) there was a better prospect of fine weather than anywhere else; Jamkundi was said to be notorious for its small rain-fall. These places were selected by Lieutenant Herschel and Captain Haig as stations of observation. Major Tennant and Mr. Pogson, the Government Astronomer at Madras, had decided on stationing themselves at points on or near the East Coast. Thus, the observers were distributed along the line of totality, and widely separated, and there was all the more probability that some of them would have an opportunity of making the requisite observations, though others might be unfortunate and see nothing.

(62). As matters turned out, all the Survey Officers had the good fortune to witness the eclipse, and make the observations which had been specially allotted to each; but clouds prevailed to a greater or less extent in every instance, and it was only through the clouds or openings in them that the phenomena were visible from time to time. The weather was very much more favorable at Guntoor and in the neighbourhood of the East Coast of the Peninsula, than at Jamkundi and Beejapore; but it was so unfavorable, at all the stations of observation, on the days immediately preceding the eclipse, as to occasion great anxiety and discouragement.

(63). Detailed reports of the observations have already been forwarded to the Royal and the Astronomical Societies, by whom they will be published with all the accessories for furnishing complete information of the results which have been secured. I need therefore only quote the descriptions given by each of the Survey Officers of the leading phenomena which they individually observed.

(64). Lieutenant Herschel, who was stationed at Jamkundi, reports as follows:—

"About ten minutes before totality commenced, I took up my position at the telescope, and occupied the interval in final measures of the solar lines, to which any subsequent measurements might be referred. As I was thus engaged, the spectrum of what remained of the sun grew rapidly narrower, and I was watching eagerly, and it may be guessed how intently! for the final disappearance which was to reveal, in place of the solar spectrum, that of the corona, when the latter faded prematurely through the intervention of a cloud, and the precious moment was lost.

"I went to the finder, removed the dark glass and waited, how long I cannot say, perhaps half a minute; soon the cloud hurried over, following the

moon's direction, and therefore revealing, first the upper limb with its scintillating corona, and then the lower. Instantly I marked a prominence near the needle point, an object so conspicuous that I felt there was no need to take any precautions to secure identification. It was a long finger-like projection from the lower left hand portion of circumference. A rapid turn of the declination screw covered it with the needle point, and in another instant I was at the spectroscope. A single glance and the problem was solved, THREE VIVID LINES—RED, ORANGE, BLUE; NO OTHERS, AND NO TRACE OF A CONTINUOUS SPECTRUM.

"From that time until the end of the 5 minutes I was endeavoring to seize the fitful glimpses of these lines for purposes of measurement. I succeeded with the orange and blue, but there was not sufficient time for the 3rd. The field became suddenly re-illuminated, and the total eclipse was over. Nothing more could be done except to check the measurements against those of the solar spectrum."

(65). Lieutenant Campbell was with Lieutenant Herschel at Jamkundi; he reports that he only saw the eclipse fitfully through openings in the clouds, for an aggregate period which he estimates at somewhat less than half that of totality. The alternate appearance and disappearance troubled him greatly, but he can still speak with certainty on the following points:—

"1*st*.—When using the double image prism, the strong difference in color of the two images of the corona, and the absence of such difference in the case of the most prominent red flame. 2*nd*.—With the Savart's polariscope, the bands from the corona were decided. With a low power, they were wanting in intensity and color (excepting alternate black and white) making it difficult to specify the nature of the centre,—and their position was at right angles to the limb, extending over a space of about 30° of the circumference; when the polariscope was turned, the band travelled bodily round the limb, without other change in position or arrangement, as if indeed they were revolving round the centre of the sun as an axis. With a higher power, when a smaller portion of the corona was embraced, the bands were brighter, colored, and seen in a different position, *viz*., as tangents to the limb."

(66). Captain Haig was stationed at Beejapore. The sky was so heavily laden with clouds that he had given up all hope of witnessing any of the phenomena of totality, when a sudden opening disclosed the eclipse. With the aid of a theodolite, on which he had mounted the prism cap of one of the hand spectrum telescopes, he observed two red flames on the left of the vertex.

"Separated from each other by a small interval, so that their spectra, which were identical, were extended over the dark back ground of the moon's disc, and stood out in most marked contrast with the feeble but continuous spectrum of the corona. In their spectra were two broad bright bands quite sharply defined, one rose madder, and the other light golden. These spectra were soon lost in the spectrum of the moon's edge just before emergence, which had also two well-defined bright bands, one green and one indigo, about a quarter of the width of the bands in the spectra of the flames; this spectrum being again soon lost in the bright sun-light."

(67). Captain Branfill was stationed with Major Tennant at Guntoor, and took observations for polarity. He reports as follows:—

"With the finder I directed to the highest part (the south-east quarter) of the corona, and examined its light carefully with the Nicoll's prism and crossed quarts, which gave brilliant light dark and colored bands (Savart's). I noted the position of the maximum white band, and the points of disappearance on each side. It was directly clear to me by several trials that the

corona was plentifully polarized in all the planes passing through the sun's centre. The double image prism gave the same results as the plain Nicoll. The polarized light was most where the corona was brightest, least where faintest. Satisfied of this, I turned to examine the light of the horn-like red flame; the corona seemed fainter behind it; but though I contracted my field I could not of course exclude all corona light. I could not detect the presence of polarized light on the red flame. With the double image prism the flame did not seem to vary in tint at all; with the Savart I could not get rid of bands altogether, and I noticed that though extremely faint the bands were continued upon the moon's surface. I was still straining to see and note any differences in brilliancy with the plain Nicoll, when a flood of light in the field told me that all was over."

(68). These observations are pregnant with interest; they lead naturally to the conclusion that the "corona" is very slightly, if at all, self-luminous, but owes its brilliance mainly to the light of the sun; while on the contrary the "red flames" are self-luminous, and composed of intensely heated gaseous matter.

THE PENDULUM OBSERVATIONS.

(75). These operations have been prosecuted very rigorously during the present year, in conformity with the original programme of observations of vibration in vacuo at certain stations of Colonel Everest's arc, with the two pendulums which were supplied by the Royal Society, and have been described in previous reports. Proceeding southwards from the Himalayas, Captain Basevi had, in the two preceding years, completed observations down to the station of Ehmadpur, lat. 23° 36′. This year the pendulums were swung at no less than 5 stations, Badgaon, Somthana, Damargida observatory, Kota Kodungul, and Namthabad, bringing the operations down to lat. 15° 6′; thus about two-thirds of the pendulum observations on the arc have now been completed.

PERSONNEL.

Captain J. P. Basevi, R. E., Surveyor, 1st Grade.
Mr. W. M. Lemarchand, Sub-Assistant, 3rd Grade.
„ J. W. McDougall, Sub-Assistant, 3rd Grade.

(76). At the commencement of the field season, Captain Basevi had to visit the Bombay observatory, in order to test his magnetic instruments by comparing their results with those of the standard magnetometers in that observatory, for reasons which will be explained in the next section. He availed himself of the opportunity to take the pendulums with him, and determine their weights and specific gravities, with the aid of the apparatus which is employed for such purposes in the Bombay Mint. The results thus obtained will probably be of much value in the final reduction of the observations.

(77). Captain Basevi has continued to devote much attention to all points, the investigation of which might tend to improve the accuracy of the results of the operations, by bringing facts to light which have any bearing in the performances of a pendulum. For instance, the accuracy of the temperature corrections depends on the thermometers truly indicating the temperature of the pendulum; it was uncertain whether they actually did so, under the ordinary conditions of observation for several consecutive hours of the day, in a uniformly varying temperature, always hotter at the close than at the commencement of the observations; under

such circumstances the temperature of the pendulum *might* lag behind that indicated by the thermometers. To ascertain whether this is actully the case, at Damargida Captain Basevi took complete sets of observations with both his pendulums, lasting 8 or 9 hours of the night, from about 8 P. M. to 5 A. M., in addition to the ordinary diurnal observations which are of similar duration;—thus, the night observations were taken under a falling temperature, and the day ones under a rising temperature. The results seem conclusive as to the fact that lagging exists to an amount which, though very minute, is still sufficiently appreciable to necessitate its recognition in the final reduction of the observations.

(78). In my last report I described the steps which had been taken for determining the factors of expansion of the two pendulums, and pointed out that they led to the singular and unexpected conclusion that "expansions determined by the vibrations of pendulums under a very low pressure are materially greater than those obtained by vibrations in the air, or by direct measurement." I added that "whether this is due to an actual increase of expansion for a decrease of pressure, or to the action of other phenomena which are at present unknown or only imperfectly known, is a problem of future solution." I have invited the attention of some of the most eminent European savans to this point, but as yet nothing conclusive has been established. The following suggestions have, however, been received from Professor G. G. Stokes:—

"I can see one cause acting in such a direction as to explain the effect observed, but whether the amount named be sufficient to explain the result, I am not prepared to say. According to Maxwell the viscosity of air increases with the temperature. Now, what would be the effect of increasing viscosity? In a pendulum surrounded by *free* air, doubtless to increase the time and diminish by degrees the arc. But if the pendulum is closely invested by a rigid envelope, the effect is not the same. Evidently, when the viscosity is very great, the instantaneous motion of the air tends to depend solely on the instantaneous motion of the pendulum, and consequently the effect of resistance, so far as viscosity is concerned, tends to fall *wholly on the arc*. With a hampered pendulum (I mean one round which the *air* was hampered, the pendulum itself being free) I should expect the effect of increasing viscosity to be, first to increase, and afterwards to diminish the time, the rate of diminution of the arc increasing all along."

Professor Balfour Stewart writes:—

"I feel certain in my own mind that it is not due to an actual increase of expansion for a decrease of pressure. To what it is due is a different question. I hazard the following remark:—I fancy it will be shown that the effect of air is of two fluids, one varying with the density, the other independent of the density, but varying with the temperature of the air. I can imagine that this may, nay that it must make, the temperature in air somewhat different to that in vacuo, but whether it will account for such a difference as you have obtained, I am not prepared to say."

MAGNETIC OBSERVATIONS.

(79). During the last two years magnetic observations have been taken in connection with the operations of the department, with unifilar magnetometers and declinometers and dip circles, which were constructed for the Indian

PERSONNEL.
Captain J. P. Basevi, R. E.
W. H. Cole, Esq., M. A.

Survey under the superintendence of General Sabine and Mr. Balfour Stewart, and were tested at the Kew observatory. But the resulting value of the 'horizontal intensity' at Mussoorie differed very materially from what had been obtained at the same station (though not on exactly the same spot) by the Messrs. Schlagentweit in 1855, our value being 7·286, their's 8·125, both expressed in British units. The difference seemed to be very much larger than could be due to any secular variation in the amount of the intensity that could possibly have taken place in the interval of 11 years between the observations. In order to ascertain whether there were any errors in our instruments or our *modus operandi*, Captain Basevi was directed to take an independent set of observations with his instruments at the Bombay magnetic observatory; this was done last November, and the result—horizontal force = 8·068, was absolutely identical with the value simultaneously determined, under Mr. Chamber's directions, with the instruments appertaining to the observatory. Moreover the mean annual value of this element at the Bombay observatory was 7·943 in 1847, and 8·025 in 1857, with which the value now obtained in 1867 is satisfactorily accordant. I have therefore much reason to believe that our results are quite correct.

(80). Our value of the total intensity at Mussoorie is 1·06 less than that given by the Messrs. Schlagentweit in the 1st volume of their "Scientific Mission to India and High Asia." But the differences between our values of this element and those given in the Messrs. Schlagentweit's chart of Isodynamic lines are less, and appear to decrease as the latitude decreases; thus, at 8 stations between 20° and 30° the average difference is ·45, and at 6 stations between 15° and 20° it is ·21, our values being always smallest.

(81). The following is a synopsis of the monthly observations which have been taken up to date by Mr. W. H. Cole, M. A., at the head-quarter's office in Dehra Doon :—

Station.	Latitude and longitude.	Month and Year.	Magnetic Elements.				Remarks.
			Declination.	Horizontal Intensity.	Dip.	Total Intensity.	
	° ′		° ′ ″		° ′		
Dehra	λ 30 20	June 1867	...	...	41 30·27	...	
	L 78 6	July „	...	7·2785	41 31·18	9·7187	
		August „	...	7·2854	41 26·12	9·7176	
		Sept. „	...	7·2830	41 29· 5	9·7230	
		October „	...	7·2870	41 27·28	9·7227	
		Nov. „	3 3 17·1 E.	7·2954	41 29·68	9·7401	
		Dec. „	...	7·2944	41 28·85	9·7367	
		January 1868	3 2 14·4 E.	7·2944	41 27·38	9·7328	
		February „	...	7·2915	41 27·06	9·7322	
		March „	...	7·2990	41 25·19	9·7336	
		April „	...	7·2811	41 29·98	9·7216	
		May „	...	7·2803	41 33·02	9·7281	
		June „	...	7·2900	41 29·28	9·7317	
		July „	...	7·3053	41 34·04	9·7642	
		August „	...	7·2923	41 28·74	9·7333	
		Sept. „	3 3 4·2 E.	7·2887	41 32·45	9·7379	
		October „	3 2 12·6 E.	7·2762	41 29·96	9·7150	

(82). The following is a synopsys of Captain Basevi's observations. Each result is usually the mean of two independant determinations on as many days, the number varying from two to seven at each station :—

Station.	Latitude.	Longitude.	Month and Year.	Magnetic Elements.				Remarks.
				Declination.	Horizontal Intensity.	Dip.	Total Intensity.	
	° ′	° ′		° ′		° ′		
Deyrah ...	30 20	78 6	January 1867 ...	E 2 51·2	7·2877	41 27·57	9·7244	The H. I. at Somtana was determined from the mean of 4 observations on the 23rd December and 1st January all very accordant. The character of the rock is trap; a good deal of iron is worked in the neighbourhood, the possible presence of which may account for the discordance in H. I. and Dip.
Meerut ...	28 59	77 44	,, ,, ...	,, 2 45·6	7·4062	39 7·24	9·5463	
Agra ...	27 9	78 2	February ,, ...	,, 2 46·2	7·5565	36 1·36	9·3430	
Pahargurh.	24 56	77 41	March ,, ...	,, 2 10·0	7·7070	31 59·31	9·0868	
Kalianpur.	24 7	77 42	March & April 1867.	,, 1 49·0	7·8461	30 17·84	9·0872	
Ehmadpur.	23 36	77 43	April 1867 ...	,, 2 6·2	7·7607	29 53·79	8·9520	
Chickuldah.	21 24	75 56	October ,, ...	,, 1 54·0	7·9804	25 42·41	8·8570	
Badgaon ...	20 44	77 39	November 1867	,, 0 55·1	7·9704	22 40·89	8·6386	
Somtana ...	19 5	77 42	Dec. 1867, Jan. 1868.	,, 0 28·1	8·3000	23 42·61	9·1635	
Damergidda.	18 3	77 43	January 1868 ...	,, 1 29·4	7·9955	19 33·04	8·4947	
Secunderabad.	17 27	78 32	February ,, ...	,, 1 34·1	8·1239	17 16·99	8·5080	
Kodungul.	17 8	77 41	March ,, ...	,, 1 28·8	8·0635	16 36·44	8·4145	
Kurnool ...	15 50	78 6	,, ,, ...	,, 1 20·7	8·0726	13 42·79	8·3095	
Namthabad.	15 0	77 36	April ,, ...	,, 1 10·6	8·1113	11 40·93	8·2829	
Bangaloro ...	12 59	77 39	June and July 1868.	...	...	7 7·44	...	

EXTRACT FROM A REPORT BY LIEUTENANT T. T. CARTER, R. E., ON THE SURVEY OPERATIONS IN CONNECTION WITH THE ABYSSINIAN EXPEDITION.

The survey party to accompany the Abyssinian field force was organized at the desire of His Excellency Sir Robert Napier, Commander-in-Chief, and was composed as follows :—Officer in charge, Lieutenant T. T. Carter, R. E., Surveyor, G. T. Survey of India; Assistants, Lieutenant A. E. Dummler, R. E., Assistant Surveyor, G. T. Survey of India, and Lieutenant T. H. Holdich, Assistant Surveyor, Topographical Survey of India, with a Native establishment of 40 (forty) classies.

The first intimation of the survey party being required, and my having been selected to the charge of the same was made to me about the middle of the month of October. Lieutenant Holdich and myself were at the Head-Quarters of the G. T. Survey at Dehra Doon; Lieutenant Dummler at Poona, with the Bombay party under Captain Haig, of the Royal Engineers. No time was lost in making the necessary arrangements, and it having been intimated that the party need not be at Bombay

till the 1st of December 1867, up to the 11th of November I was employed with Lieutenant Holdich under instructions from Lieut. Colonel Walker, R. E., in taking astronomical observations, and practising with the view of accustoming ourselves to the astronomical work which would form part of our survey operations.

On the 11th of November 1867, I left Dehra, accompanied by Lieutenant Holdich, and taking with me 10 (ten) classies, natives of the hills, and accustomed to the survey work in the Himalayas; Captain T. G. Montgomerie, R. E., the Officer in charge of the Kumaon and Gurhwal Series, having kindly permitted me to take such men of his party who were willing to accompany me. The services of these men I subsequently found most useful.

I proceeded by rail from Meerut to Jubbulpore, marched across to Nagpore, and thence by rail to Bombay, arriving there on the 30th of November. At Bombay, I was joined by Lieutenant Dummler and the rest of the classies; these latter were, with few exceptions, men new to the work and entertained at Poona.

It was the 13th of December before the party embarked, so that ample time was afforded for such equipment as I thought necessary to take with me, and providing the classies with warm clothing, &c.

The instrumental equipment consisted of—

A portable transit instrument.

Two 6″ theodolites, fitted with micrometers in the eye piece, with the view to using them for traversing in hilly country and 2 prismatic compasses, with the same micrometer arrangement; 3 plane-tables and stands and a battery of 4 chronometers, as well as aneroid barometers and boiling point thermometers, for determining the altitudes of different places.

The chronometers were rated at the Bombay observatory before starting.

The party arrived in Annesley Bay on the 4th of January, and disembarked on the 8th; it was the 15th before any carriage could be furnished, all available carriage at the time being required for the conveyance of provisions to the front. In the mean time, having reconnoitered the country at the foot of the hills, I determined to measure a base-line near Koomaylee, the first march towards Senafe. The ground here was level, but free from heavy jungle, though much cut up with ravines; but by means of the subtense instruments, a base-line of 5146·9 yards was measured, and from the extremities of this base, two points on the lower spurs of the hills were fixed, 8 miles apart, and on this side, the triangulation was extended, fixing several commanding peaks at distances from 10 to 20 miles off. Observations were taken at one extremity of the base-line to determine its latitude, and also the azimuths of the other extremity. These observations having been worked out, I was enabled to project a plane-table, and to lay down on it the points I had fixed by triangulation, and I directed Lieutenant Holdich to take up the plane-tabling of the country from Zoola to Senafe, and to sketch inasmuch of the same on either side of the line as circumstances permitted. I also requested him to take a theodolite, and when visiting those peaks already fixed, to extend the triangulation; by this means, I hoped to connect this portion of the triangulation with the new base I intended measuring near

Senafe; but to make certain of having a connection between these two base-lines, I directed Lieutenant Dummler to carry a traverse from one end of the Koomaylee base, and to join on with the Senafe base. By the 1st of February, Lieutenant Holdich had left me on independent work, and I proceeded to Senafe, arriving there on the 5th of February, measured the new base-line, and fixed several points in advance; projected a plane-table, and took up the sketching of this portion of the country. On the 10th of February, Lieutenant Dummler connected the base-line at Senafe with the Koomaylee one by the traverse. Some delay was occasioned here on account of working out the traverse, Lieutenant Holdich having written to me for the same, and reporting that the weather was so unfavorable, cloudy and rainy; he had ascended a few of the higher peaks on either side of the line of march, but always to find himself surrounded with clouds. He had tried remaining on the peaks all night, but with no success, the clouds always rising with the sun and shutting out everything from his view. His Excellency the Commander-in-Chief had written to me for a sketch of this portion of the country, being most anxious to find a route from the high land to the coast, by which to turn the difficult defile of the Looroo Pass. Lieutenant Holdich suggested leaving this portion of the country to be done later, but for the reason above mentioned, and also because I thought it unadvisable to leave any gap in the work, depending for its completion on such opportunities for survey work as the return march would allow of, (no such opportunities were afforded, on the return of the army). I directed him to remain and complete the sketching of this part of the country as the weather permitted, and I am happy to say that by the 12th of March he had completed the survey of—square miles of very difficult country up to Senafe, and had been instrumental in finding a road by which the Looroo defile was turned. By this time I had completed the survey of about—square miles beyond Senafe, and I now requested Lieutenant Holdich to continue sketching from the point I left off, towards Adegerat, while I proceeded to Antalo to measure a third base. Lieutenant Dummler had in the meanwhile continued the traverse to Antalo, and I now intended him to plane-table back to meet Lieutenant Holdich. This was ultimately done, and a continuous survey of the line of march, showing the topography of the country on either side for a distance of from 10 to 15 miles, was finished by the 6th of April, completing the survey to Antalo. The march of the army was so rapid, and it being impossible to carry more than a few days' supplies on account of scarcity of carriage, prevented a continuous series of triangles being carried on. The system I then adopted was measuring base-lines at distances of about 40 miles from each other; building one or two figures on these bases and fixing points, and connecting the bases by traverse. I hoped in this way to have plane-tabled a large portion of the country on either side of the line of march, but the nature of the country beyond Antalo prevented our going off the line. Plane-tabling was carried on to a point 20 miles beyond Lake Ashangi, though the amount of the country sketched in on either side was considerably less than what was able to be done up to Antalo, on account of the plane-table having to accompany the traverse.

On arriving at Antalo on the 19th of March, I found His Excellency the Commander-in-Chief advancing so rapidly on Magdala that

I proceeded at once to Lake Ashangi, leaving a gap of 50 miles to be filled in subsequently by Lieutenants Dummler and Holdich. At Ashangi I measured a 4th base, and having fixed a sufficiency of points, proceeded to sketch in the country in advance. At Ashangi, the continuous hard work, without the amount of stimulant and food to which one was accustomed, began to tell, and I found I could not do the same amount of walking, &c., as I had hitherto done; and after plane-tabling as far as Murawur, the 3rd march from Ashangi in advance, I was obliged to abandon the plane-table, and carry on the traverse alone. The Commander-in-Chief was now close on Magdala, and I had neither time nor was I able single-handed to do more than traverse. I succeeded in carrying on the traverse as far as Magdala, arriving there on the morning of the 13th, the day of the assault. After the taking of Magdala and up to the 20th, I was employed at Sir Robert Napier's desire in making a plan of the position and neighbouring country on the scale of half a mile to the inch (this plan was completed and made over to Sir Robert Napier on his arrival in England).

Virtually, the expedition was now at an end, and the Medical Officers being of opinion that I should for the present give myself a rest, I proceeded on the return march to the coast, a few days in advance of the main column. At Ashangi, I met Lieutenants Dummler and Holdich, who had completed a route survey between Antalo and Ashangi. I made over the charge of the party here to Lieutenant Dummler, requesting him to extend the work if possible on the return march; but no opportunities were afforded of doing anything more, and the survey party arrived at Zoola on 30th of May. Lieutenant Dummler endeavored to connect the end of the base-line at Koomaylee with the harbour at Zoola by traverse, and when doing so, received a sun-stroke which disabled him from doing any further work.

No observation for determining a longitude had yet been taken, and this piece of the work devolved on Lieutenant Holdich who was kindly assisted by Captain Darrah, R. E. (an Officer who was employed on the British Columbian Boundary Commission). A longitude of Zoola was determined by the method of moon culminating stars, with results as stated in the margin, and I dare say the result will agree more closely when corrected for increase of moon's right ascension determined by actual observation at Greenwich observatory, where it is proposed to send the computations for final correction.

Zoola east of Greenwich.

	h.	m.	s.	
June, 1st	2	38	50·41	Observed before full-moon.
„ 2nd	2	38	45·97	
„ 3rd	2	38	52·47	
„ 4th	2	38	58·66	
„ 5th	2	39	15·73	Observed after full-moon.

Several observations of moon's zenith distance were also taken for longitude, but these have not yet been worked out. On the 30th of May, at the recommendation of a Medical Board I left for England; on the 5th of June Lieutenant Dummler also left, and we were followed on the 12th by Lieutenant Holdich, with the records, &c., the Government of India having sanctioned our all proceeding to England for six months, with the view to the completion of the work, and Her Majesty's Government having approved of the same.

The native establishment, with the instrumental equipment, were sent to Bombay in charge of Captain Pottinger, R. A., of the Quarter Master General's Department; the instruments were consigned to care of Captain Ducat, R. E., Executive Engineer, Bombay.

The hurried nature of the expedition, the difficulty of moving off the line of march, and the weather were all unfavorable for survey work; and it was only by very great exertion that the party was able to complete the survey of as much of the country as it did.

In conclusion I would beg to bring to the notice of the heads of their different departments, the services of both Lieutenants Dummler and Holdich.

Out-turn of Work.	No.
Longitudes measured by moon culminating stars	1
Longitudes measured by moon zenith distances	1
Base-lines measured	5
Triangles observed, all three angles measured	8
No. of intersected points fixed	50
No. of heights observed with theodolite	30
No. of heights determined by boiling thermometer ...	50
Latitudes determined by circum-meridian altitude ...	8
Latitudes by observation to the pole star	6
Azimuths observed	5
Miles of traversing with subtense instrument	400
No. of square miles surveyed on 1 inch scale	7000
Plan of Magdala position on 1 mile to inch	70 square miles.

Connected with the astronomical latitude, longitude, and azimuths were some 50 time observations.

The party are at present doing office duty at the Topographical Department of the War Office, London, but results of their operations will be compiled in one report, on the completion of the work.

EXTRACTS FROM THE REPORTS ON THE TOTAL ECLIPSE OF 18TH AUGUST 1868.

LIEUTENANT HERSCHEL'S REPORT.

(3). It is perhaps necessary in the first place to explain the circumstances under which I became connected with these observations as an employé of the Royal Society of London. Attention was drawn to this eclipse as important to science by Major Tennant, R. E., early in 1867. I was at that time in England on sick leave, and in May of that year, a proposal was made to me, on the part of the Royal Society, to undertake certain observations of a definite character (the nature of which I shall have occasion to describe presently) should my return to India and other considerations make it possible. As you are aware I accepted the proposal subject to your approval, and accordingly the Royal Society decided to purchase instruments suitable to the occasion, while I turned my attention to the branch of science involved—that of "spectral analysis,"—and addressed you with a view to ascertaining how far I was justified in accepting the position.

(4). It thus came about that, on the expiration of my leave, I returned to India in charge of certain instruments entrusted to me by the Royal Society; and with a paper of instructions, indicating the character of the desired observations, in my pocket. I landed at Madras on the 8th December, and the eclipse was to take place on the 18th

August. The intervening time was in great measure devoted to my professional duties as a member of the Survey Department—first in assisting at the measurement of the base-line at Bangalore, and afterwards in the computations arising out of it, but the whole of my leisure was spent in practising with the instruments and in preparations and arrangements. As these were necessary rather than interesting I need not enter into details about them, further than to show the precautions requisite to ensure, if not actual success, at least a reasonable probability of it.

(5). It is necessary, however, before proceeding further that I should sketch the nature of the observations proposed. That light may be separated into its constituents, and those constituents *sorted* and arranged according to their colors, in passing through a wedge or triangular prism of glass, has long been known; also that solar light so distributed produced a "spectrum" of a definite character was also known, and its peculiarities had been closely observed; but it was only within the last eight or nine years that a theory was propounded, which has since been very generally accepted, that these peculiarities, *viz.*:—Fraunhofer's lines—were due to a solar atmosphere, which, according to the theory, absorbs a portion of the light emitted by the body of the sun. This theory was based mainly on the observed identity of position in the spectrum, of these lines with those of light known to be emitted by certain definite elementary substances when intensely heated; the only difference being that the latter were *bright* lines, while the former were dark. And the explanation of this difference was that they were dark by comparison only. So that if the sun were supposed to be enveloped in vapours of the elementary substances—intensely heated indeed, and luminous perhaps, but *less so* than the central body—certain portions of the light from the latter would be absorbed, in favor of light of precisely the same kind, only less luminous, and therefore by comparison with the unobstructed light dark.

(6). The use of the prism in analyzing light is of very much larger application than any thing I have sketched here, and it would be quite out of place to attempt to explain the tests which it applies. Suffice it to say that the appearance of the spectrum may or may not indicate the source of the light as well as the chemical and physical constitution of that source.

(7). The appearances presented during an eclipse, as seen through telescopes, had suggested all manner of theories as to the constitution and nature, both of the corona and red prominences. At the last great eclipse—that of 1860—spectroscopes were unknown. It was not till two years later that sufficient advance had been made in this direction to enable Mr. Huggins, whose name is so well known in connection with this most interesting branch of physical discovery, and padre Secchi of Rome, to commence the spectroscopic examination of celestial objects. To their discoveries I need not refer further except to point out how they naturally excited a lively interest and a strong desire to apply the new implement to the solar appendages during a total eclipse, when the comparatively blinding light of the sun's body should be obscured.

To make more clear the special questions which a spectroscopical examination of the corona, &c., was expected to aid in solving, I should add that a "spectrum" has of necessity one of two characters. It is

either *continuous* or *discontinuous*, *i. e.*, the series of colors is either unbroken, or is only a series by courtesy, one or more representative colors only occupying their proper places, the rest being absent. These characters indicate whether the light emanates from a luminous solid or liquid, or from a luminous gas or vapour, and in the latter case may, and some day no doubt will indicate certainly from *what* gas or vapour.

On the supposition that the "corona" was a solar atmosphere, the questions arose, is that atmosphere a self-luminous vapour or mixture of vapours? and in that case of what vapours does it consist? or is it a non-luminous vapour rendered visible by the reflection of the solar light from its material particles? or, again, does it consist of strata showing both these characters? and others of a like kind.

Again, there was a still greater curiosity, if possible, to learn something about those strange appearances called, for want of any knowledge of their real nature, "protuberances," "prominences," "flames" and the like. Were they really flames? and if so flames of what? On all these points the spectroscope, if it spoke at all, would certainly speak the truth; and science seemed fairly able to interprete the oracle by the help of late discoveries in terrestrial physics.

The event, which so far as I was concerned in it, I now proceed to relate, has in great measure answered these questions, thereby, as in all cases of scientific search, limiting speculation and pointing the way to fresh questions, to be answered, it is hoped, on some future occasion.

The instruments placed in my hands for these observations, as well as for another kind which I shall advert to presently, were—

1*st.*—A fine equatorially mounted telescope of 62 inches focal length and 5 inches aperture, with clock-work driving machinery to ensure an automatic maintenance of direction upon a moving object; and in connection with it, though an independent instrument.

2*nd.*—A spectroscope containing a single flint glass prism for the separation or analysis of whatever light might be collected and thrown upon it by the above telescope.

The latter of these two I should observe, acts the part of a large, and in some respects inconvenient, *eye-piece* to the former, with this difference as compared with an ordinary eye-piece, that whereas the latter presents to the eye a magnified image of the object towards which the telescope is directed, the former offers no such advantage, but only receives and *sorts* the light and presents the resulting arrangement for inspection, quite devoid of any *form* corresponding to that of the real object. It will therefore be understood that I had to make up my mind to see nothing of the eclipse *as a spectacle*, with the fine telescope at my command. Nor did I: were it otherwise I should confine myself in this report to a description of a more generally interesting character than I am now enabled to offer.

Having now given an outline of the proposed objects, and sufficiently indicated the nature of the instruments, I need not dwell on the preliminary arrangements—among which however I should mention the construction of a portable wooden observatory (which I contemplated making use of afterwards for survey purposes) and the choice of a station of observation. With regard to the last, I may take this opportunity to offer my grateful acknowledgment of your energetic assistance

in procuring through the local Governments the necessary information as to climate and weather at numerous stations along the line of eclipse; and of your warm support and concurrence, in all my endeavors to obtain for the Royal Society the best chances of success; more especially in procuring the sanction of Government for the necessary expenditure; and in giving me the assistance of Lieutenant W. Maxwell Campbell, R. E.

The station selected, with your approval, was Jumkandi—a small town notorious on the Bombay side for the small rain-fall which characterizes the district in which it is situated. It is the residence of an independent native chief well known in those parts for the enlightened taste which he displays in surrounding himself with the products of European skill and refinement, as well as for other reasons. I was, perhaps unduly, biassed in this choice by the spontaneous offers of assistance made through his secretary, when the question of a suitable position was first mooted. I wish I could add that I had reason to congratulate myself on my choice. In point of fact, it was by no means an easy thing to decide. There seemed a strong probability of cloudy weather, wherever we went, at that season; and access was not equally practicable to all places. The main road through Dharwar and Belgaum might reasonably be expected to be passable even in August, and Jumkandi was distant from it only 80 miles. Nevertheless I was unwilling to risk sending my camp such a distance except in charge of an assistant. I had received your permission to avail myself, to the full extent of my requirements, of the services of Lieutenant Campbell's assistants at Bangalore. I proposed to enlist one of these gentlemen as a recorder and observatory assistant, and a second was required to take a series of independent observations of the intensity of the chemical action of sun-light during the progress of the eclipse. I believe Lieutenant Campbell was a little doubtful whether the nature of the observations with which he was entrusted would be such as to require an assistant, but other considerations arising out of his professional work and requiring the detachment of an assistant in that direction, which will no doubt find a place in his regular report, induced me to consent to this further increase to the strength of the party.

Mr. G. Anding accordingly went as Lieutenant Campbell's personal assistant, and as the senior in charge of the party. To Mr. A. Christie, I entrusted the photo-chemical apparatus, and instructed him in the use of it: while Mr. J. Bond accompanied the party to act eventually as my assistant.

The party left Bangalore on the 7th July, and reached Jumkandi on the 9th August, having made a very creditable march of 392 miles over very bad roads in 34 days, including halts.

Lieutenant Campbell and myself followed later, arriving at Jumkandi on the 14th. On the evening of the same day the observatory was up and the instrument in position, but unadjusted.

Before proceeding further, I will endeavor to describe the nature and object of the special observations which Lieutenant Campbell was about to secure. I have said that some of the questions which it was desirable to have answered, if possible, had reference to some remaining uncertainty as to whether the corona was or was not a solar atmosphere; or whether it was not possibly of the nature of a terrestrial atmospheric

halo. This question appeared to be susceptible of solution by the help of the "polariscopes"—an instrument for indicating the *plane of polarization* of light. Light being alway's more or less polarized by reflection, it was surmised that, if the corona was *reflected* solar light, it should show some traces of this peculiarity when viewed with the polariscope, which instrument would at the same time indicate the plane of polarization, and therefore the probable position of the reflecting surface with regard to the source of light. It is hardly necessary to add that the polariscope is merely an adaptation to a telescope, of one or other of certain peculiar combinations of crystalline plates. This instrument does not, as in the case of the spectroscope, materially affect the form or appearance of the object. In one case it presents two distinct fields of view, identical in every respect, except that they are differently tinted when polarized light is present: in the other, one view only is presented crossed by more or less faintly shaded and colored parallel bands, the direction and arrangement of which give the required information as to polarity. So much of explanation seems necessary in connection with Lieutenant Campbell's report, copy of which I enclose.

I should also state that the Royal Society furnished me with four small instruments called "hand-spectroscopes," for distribution according to circumstances. I was at some pains to give these instruments a fair chance, but up to the present time I have received no reports from which anything material can be gathered.

Two other instruments which I brought out myself of a like nature, and which I lent to Mr. C. S. Chambers, Government Astronomer at Bombay, were rendered useless in his hands by cloudy weather. On the whole, these instruments have fared so badly that there seems no occasion to describe them here.

I may now return to the principal subject of this report, to which the greater part of the foregoing remarks must be considered as necessary an introduction, as the actual preliminaries were to the event. The interval from the 14th to the 18th August was occupied, as may be supposed, in anxious preparation and uncertainty. The weather was far from promising, being persistently cloudy; but we entertained hopes each day that it would be the last of an unusually protracted interval of such weather in that country. The uncertainty as to the phenomena to be witnessed, combined with the uncertainty as to the space of time which the clouds might allow for observing them, rendered it almost impossible to lay down a definite course of action, and greatly heightened the nervous apprehension otherwise so natural to the occasion. To this cause I must attribute the almost complete abstraction whose result is so evident both in my own personal recollections of that morning and in the absence of any observations of a generally interesting character which one might fairly be supposed to have made. I was closely imprisoned from 10 minutes before to nearly the same time after the total phase, and was sensible to *nothing* external but the hum of voices around me.

About 10 minutes before totality commenced I took up my position at the telescope and occupied the interval in final measures of the solar lines to which any subsequent measurements might be referred. As I was thus engaged, the spectrum of what remained of the sun grew rapidly narrower, and I was watching eagerly—and it may be guessed how

intently! for the final disappearance which was to reveal, in place of the solar spectrum, that of the corona, when the latter faded prematurely through the intervention of a cloud, and the precious moment was lost.

I went to the finder, removed the dark glass, and waited how long I cannot say, perhaps half a minute. Soon the cloud hurried over, following the moon's direction, and therefore revealing, first, the upper limb with its scintillating corona and then the lower. Instantly I marked a prominence near the needle point, an object so conspicuous that I felt there was no need to take any precautions to secure identification. It was a long finger, like projection from the lower left-hand portion of the circumference. A rapid turn of the declination screw covered it with the needle point, and in another instant I was at the spectroscope. A single glance and the problem was solved. THREE VIVID LINES, RED, ORANGE, BLUE; NO OTHERS, AND NO TRACE OF A CONTINUOUS SPECTRUM.

From that time until the end of the 5 minutes I was endeavoring to seize the fitful glimpses of these lines for purposes of measurement. I succeeded with the orange and blue, but there was not sufficient time for the third. The field became suddenly re-illuminated, and the total eclipse was over. Nothing more could be done except to check the measurements against those of the solar spectrum.

Of the result of this comparison I will say as little as possible for obvious reasons. My impression is that the flame I was looking at consisted principally of sodium, and *possibly* hydrogen, in an intensely heated condition; but it would plainly be premature to indulge in speculations when a little patience will supply other and independent data.

The absence of any spectrum of the corona is simply negative evidence, and nothing more can be based on it than the presumption that it was faint and probably "continuous," which would imply reflection of solar light rather than intrinsic luminosity. On this point also reserve is better than hasty speculation, although the conclusion to be derived from Lieutenant Campbell's observations of polarity, that the corona is not self-luminous, but only a reflecting agent, is irresistable.

LIEUTENANT CAMPBELL'S REPORT.

I was deputed to accompany Lieutenant Herschel on his expedition to observe the phenomena of the total eclipse, and to use the instruments supplied by the Royal Society for the observation of polarized light in the corona and red flames.

The instruments in question were as follows:—

A telescope of 3 inch aperture, mounted on a rough double axis, admitting of motion in azimuth and altitude by hand only, unaided by any appliances for clamping and slow motion. The telescope was provided with three eye-pieces of magnifying powers of 27, 41, and 98, and with it were furnished two analyzers for polarized light, *viz.*, a double image prism and a "Savart's polariscope."

The first gives two images of the object viewed, which, when polarized light is present, become strongly colored with complimentary tints, by whose changes, according to the position in azimuth of the analyzer, the plane of polarization may be found.

The second shows the presence of polarized light by the formation, across the image of the object viewed, of colored bands, which alter in arrangement, and intensity according to the position of the polariscope with reference to the plane of polarization, and hence afford a means of arriving at a knowledge of the latter.

With the former, slight polarization would probably be more readily recognised at a glance, while with the latter, the plane of polarization could be more easily and accurately determined.

To carry these analyzers I had a pair of jointed arms constructed, so attached by a collar and screw to the eye tube of the telescope as to admit of the eye-piece being changed.

Each arm carried one of the analyzers in a cell, in which a rotatory motion could be given for analyzing purposes.

Either analyzer could in this way be brought instantly into position before the eye-piece of the telescope, or both could be turned aside, and the telescope used by itself at pleasure.

Immediately behind this apparatus a circular piece of card-board of about 12 inches diameter and neatly graduated was firmly attached to the eye tube, and to each analyzer was affixed a long pointer, by which its azimuth could be referred to the graduations on the card circle, should measures of position or change of azimuth appear desirable. I was also furnished with a hand-spectroscope for direct vision.

The point chosen for my station was on the northern slope of a low range of hills, about 1½ miles west by south of Jamkundi.

The flatness of the hills on top offered no point from which an uninterrupted view could be obtained in all directions, and from my station I only obtained a view of the northern half of the distant horizon over the plains, extending in that direction for many miles, above the general level of which I was raised about 200 feet.

Early on the morning of the 18th I proceeded to the spot, having previously sent up the instruments and a tent for shelter in case of necessity.

At sunrise the sky was beautifully clear, except in the northern horizon, where there were low clouds lying over the river Kistna. There was a gentle breeze from west by south-west.

A little later, light, flocculent clouds began to rise, and form in an arch overhead from west to east, continuing to increase as the morning wore on; then a light scud set in, and turned gradually into broken masses of thick dark clouds.

Before the commencement of the eclipse, I took observations for time with a small theodolite, from which I computed the error of my chronometer (a mean time chronometer by McCabe) to be 1*h*. 14*m*. 55·2*s*. *fast* on local apparent time, and by that quantity I have accordingly corrected all observed chronometer times in the statements of time which follow.

I observed the first contact which took place at 7*h*. 45*m*. 13*s*. (local apparent time) about 15° from the vertex, after which I watched the progress of the eclipse, and noted the time of occultation of three spots which were visible on the sun.

During the progress of the eclipse, I observed no unevenness in the moon's limb, nor any want of sharpness in the cusps—using magnifying power 27.

The following notes were taken on the spot :—At first contact, sun very slightly obscured by flying clouds. At 8*h*. clouds thick and gathering, rising from south-west and west.

Wind higher and gusty.

h.	*m.*	
8	10.	Clouds overhead, increasing and thickening, and rising steadily from west.
8	20.	Sky nearly entirely overcast, clouds thickest in neighbourhood of sun.
8	25.	A clear break.
8	30.	I thought I could discern very faintly the dark limb of the moon beyond that of the sun, and at this time, making allowance for the general cloudiness, I did not perceive any decrease of light on the landscape.
8	40.	But 10 minutes later the darkening was decided.
8	45.	Thick clouds well broken up still gathered most closely in the region of the sun. Light becoming lurid, and increase of darkness very apparent.
8	52.	Cusps perfect (magnifying power 27).

Closely before totality, a bright line of light appeared to shoot out at tangent to the moon's limb at its vertex, as if running across the bright crescent of the sun (though, of course, not visible against the superior light), and extended beyond each cusp to a distance of nearly or quite 15 minutes. The corona became visible immediately after, between the dark limb of the moon and the bright line. The corona did not appear so bright as the line, the brilliance and whiteness of the light of which was most striking. This was seen through a lightly smoked glass. At this period, probably not more than 3 to 5 seconds before totality ensued, a thick cloud shut out everything, and the rest of the phenomenon was only seen fitfully through openings in the clouds—for an aggregate period, which I estimate at somewhat less than half that of totality.

This alternate appearance and disappearance troubled me greatly, and gave rise to nervousness and excitement, for, owing to the imperfect mounting of my telescope, I was apt to lose my place whenever the light was cut off by clouds, and waste the precious moments of clearness in finding it again. On the first opportunity after the commencement of totality, I turned on the double image prism, with the eye-piece of 27 magnifying power, as recommended in the "instructions," which gave a field of about 45′ diameter. A most decided difference of color was at once apparent between the two images of the corona, but I could not make certain of any such difference in the case of a remarkable horn-like protuberance, of a bright red color, situate about 210° from the vertex reckoned (as I have done in all cases) with reference to the actual, not the inverted image, and with direct motion. I then removed the double image prism, and applied the Savart's polariscope, which gave bands at right angles to a tangent to the limb, distinct but not bright, and with little if any appearance of color. On turning the polariscope in its cell, the bands, instead of appearing to revolve on their own centre, passing through various phases of brightness and arrangement, &c., travelled bodily along the limb, always at right angles thereto, and without much change in intensity, or any at all in arrangement.

The point at which they seemed strongest was about 140° from vertex, and I recorded them as black centred.

Believing that with a higher power and smaller field I should find it easier to fix my attention on one point of the corona, and observe the phases of the bands at that point, I changed eye-pieces, applying that of 41 power.

With this eye-piece, the first clear instant showed the bands, much brighter than before, colored, and as tangents to the limb, at a point about 200° from the vertex; but before I could determine anything further, a cloud shut out the view, and a few seconds later, a sudden rush of light told that the totality was over, though it was difficult to believe that 5 minutes had flown by since its commencement.

I experienced a strong feeling of disappointment and want of success, the only points on which I can speak with certainty being as follows:—1*st*, when using the double image prism, the strong difference in color of the two images of the corona, and the absence of such difference in the case of the most prominent red flame; 2*nd*, with the "Savart's polariscope." The bands from the corona were decided. With a low power, they were wanting in intensity and color (excepting alternate black and white), making it difficult to specify the nature of the centre, and their position was at right angles to the limb, extending over a space of about 30° of the circumference. When the polariscope was turned the bands travelled bodily round the limb, without other change in position or arrangement, as if indeed they were revolving round the centre of the sun as an axis. With a higher power when a smaller portion of the corona was embraced, the bands were brighter, colored, and seen in a different position, *viz.*, as tangents to the limb.

The appearance observed with the low power seems exactly what might be expected, supposing the bands to be brightest at every point when at right angles to the limb, in which case the bands growing into brightness at each succeeding point of the limb would distract attention from those fading away at the points passed over as the analyzer revolved.

After totality was over the clouds cleared somewhat, and I watched the eclipse till its conclusion, noting the times of emersion of the spots, last contact, &c.

A light shower fell at 9-30.

During totality several stars and planets were seen by those who were with me, and a fowl, which I had placed near me out of curiosity, was observed to compose itself to sleep. It was at no time so dark as I had expected. After the commencement of the total phase, I read the chronometer, and wrote notes in pencil without difficulty, and the light of a bull's-eye lantern, when thrown on my paper, appeared somewhat dull.

The brilliance of the light of the corona, when it burst out through the openings in the clouds, astonished me. Also the very gradual decrease of light before totality, and the wonderful flood which followed the instant of the sun's limb's re-appearance (though behind a cloud), was very striking.

I was too much occupied in watching the position of the sun, so as not to lose an instant of the precious intervals of clearness, to see

much of the general effect. I had no opportunity of using the hand-spectroscope. There was no one in my neighbourhood (except those of my own party, who had been warned to keep silence), but when totality commenced, a wailing shout was heard in the distance, apparently rising all round us, which was succeeded by silence after a few seconds. The distant features of the landscape disappeared, and I noticed one light, apparently a village fire, some miles distant.

I give below the different times I observed, as of possible interest.

Local apparent time is used.

		h.	m.	s.		h.	m.	s.
Sun and moon,	1st contact ...	7	45	13	last contact ...	10	21	59
Spot No. 1	1st „ ...	7	57	39				
	entire disappearance	7	59	5	entire re-appearance	9	7	5
Spot No. 2,	1st contact ...	8	40	28	ditto ditto ...	9	54	39
„ „ 3,	1st „ ...	8	46	58	ditto ditto ...	10	3	25

Latitude of station 16° 30′ 10″, long. 75° 20′ 0″.

I cannot state with any approach to accuracy either the instant of the commencement or termination of totality.

CAPTAIN HAIG'S REPORT.

I may state at once that I observed the spectra of two red flames close to each other, and in their spectra two broad bright bands quite sharply defined, one rose madder and the other light golden. These spectra were soon lost in the spectrum of the moon's edge just before emergence, which had also two well defined bright bands, one green and one indigo, about a quarter the width of the bands in the spectra of the flames, this spectrum being again soon lost in the bright sun-light.

I will now proceed to give a detailed account of the observations in which Captain Tanner (Bombay Staff Corps, of the Nimar survey, who at my earnest solicitation accompanied me), and Mr. Kero Luximon, Professor of Mathematics at the Deccan College, took part, and during which Mr. Hunter (Bombay Civil Service), and Dr. Kielhorn, Professor of Sanscrit in the Deccan College, were present as non-professional observers.

Our instrumental equipment consisted as follows:—Mr. Kero Luximon brought an ordinary pedestal telescope of 2¼ inches aperture and 36 inches focal length, by Horne and Thornthwait, which he temporarily mounted on a stand equatorially, and had a scale fitted in the 60 power eye-piece, which, however, he was unfortunately not able to use on account of a fall which his instrument sustained from being blown down by the high wind; he therefore had to use another eye-piece of power 70 not furnished with a scale. He also had a pocket chronometer, beating 5 times to 2 seconds, by Arnold and Dent. Captain Tanner had an Everest theodolite, by Troughton and Simms, having a remarkably good telescope of 1⅞ inches aperture, and 18 inches focal length, and eye-piece of power 46. I had one of the Royal Society's small hand-spectroscopes, and a small 6-inch transit theodolite, by Troughton and Simms, the cap of the object glass of which I had cut so as to receive the prism cap of the spectroscope, and had fitted one to the other, so that I could *at once* shift the prism cap from its own telescope to that of the theodolite and *vice versâ*.

The sky in the early morning of the 18th was very very cloudy, so that our hopes of success were very low; but as it afterwards brightened

up for a while, rather suddenly, we were somewhat encouraged to hope for a similar brightening during part of the eclipse. Soon, however, at about 7 o'clock, it darkened again, and remained so till after the total phase was over; occasional openings in the nimbi giving us glimpses of the sun through the cirro-cumuli, which were floating very high up. At 7 o'clock we had reached our station of observation, which was on a large solid tower called the Upari Burj, 67 feet high and 60 feet diameter at top, a most favorable position from which to observe the phenomena of the eclipse and the general aspect of the surrounding country. On account of the prevailing high wind, we planted our instruments on and near the top of the external stone staircase, so as just to be protected by the tower from the wind. Mr. Kero Luximon first set up his telescope on top of the tower, but it was blown down as I have previously mentioned. This accident much interfered with the carrying out of our preconcerted plan of observations, which was as follows:—Mr. Kero Luximon and Captain Tanner were to take the times of first and last contact, the latter by observing the actual occurrences, the former by measuring several lengths of the common chord soon after first and before last contact, with the aid of the scale in his 60 power eye-piece, and noting the times. Captain Tanner (an expert delineator) was during totality to take command of Mr. Kero Luximon's telescope, measuring the heights of the flames at times, which would be recorded by Mr. Kero Luximon, whose whole attention during totality was to be given to recording the times of occurrence of any phenomena that he or either of us might observe. Captain Tanner was also to make rapid sketches of all he saw, and I was to confine myself to spectrum observations. Unfortunately, contact was not observed until about 50 seconds after the commencement, when Captain Tanner at once made a sketch of the obscuration, Mr. Kero Luximon recording the time. The sketch made the common chord=3′ at $7h.\ 51m.\ 17s.$ local time, giving $7h.\ 50m.\ 17s.$ as the time of first contact. Captain Tanner also afterwards tested that sketch by noting the time before last contact, when the chord appeared of a similar length, which gave an interval of 45 seconds, so that, taking the mean between the original estimate and its verification, we have $7h.\ 50m.\ 25s.$ as the time of first contact. While the obscuration was increasing, Captain Tanner, during the few peeps we got at the eclipse, made drawings of the sun's spots and sketched the mountains on the moon's edge, of which there were two plainly visible, even with my small theodolite. The darkness increased very slowly till just before totality, when the increase was very rapid and sudden, and a general spontaneous exclamation, "oh!" from all of us gave Mr. Kero Luximon the time of beginning of totality, which he recorded as $9h.\ 1m.\ 49s.$ The eclipse was at that time completely shut out from our view by the clouds—nimbi low down, being rapidly carried past by the high wind—we therefore felt at leisure to make our remarks on the degree of the darkness which we were surprised to find so far from total; we could easily write and read our writing and read the seconds of our watches without the aid of artificial light. We were all lamenting our misfortune in not being able to observe the eclipse, and had given up all hope of witnessing the phenomena we had come so far to see, and Captain Tanner had just noticed the faint re-appearance of light in the

west, when contrary to all expectation and to our intense satisfaction, a sudden opening in the nimbi showed us the eclipse through the cirro-cumuli. We were each at our telescopes in an instant. I immediately saw through the naked telescope of the small theodolite that red flames were visible, and at once pointed the spectroscope, using the theodolite telescope as a rest. I very fortunately directed the spectroscope with its "refracting edge" tangent to the moon, where two red flames were protruding separated from each other by a small interval, so that their spectra which were identical were extended over the dark back ground of the moon's disc and stood out in most marked and brilliant contrast with the feeble but continuous spectrum of the corona, and in their spectra here were the two broad bright bands I have described above. Most fortunately also these red flames were on that part of the sun which *first* re-appeared, so that just before or just *at* emergence, there appeared at the very part I was intently observing one brilliant wide spectrum, with the green and indigo bands before described, remaining visible for an interval just long enough to enable me to make *quite sure* of the position of the bands which were then obliterated by the bright light of the sun. Of course, observing with the spectroscope alone, it would have been impossible to say whether the spectrum with the green and indigo bands appeared just before or just after emergence; but I think it must have been just before, because Captain Tanner called out when totality was over, and I immediately remarked that I thought he was rather late, but he was quite confident about the accuracy of his observation. What struck me as being very remarkable was the circumstance that though the light of the red flames was to the naked eye so feeble as to be outshone to extinction by that of the corona, nevertheless, when viewed with the spectroscope, the spectrum of the corona was very weak and that of the flames remarkably brilliant. On the first glimpse of the eclipse, before looking through the telescope, the corona appeared so bright that it gave me the momentary impression (as it did to Captain Tanner) of its being an annular eclipse. We are divided in our estimate of the length of the interval during which we observed the totality. It appeared to me very short, so much so that when it was over I was quite taken by surprise to hear that both Captain Tanner and Mr. Kero Luximon had taken sketches of the flames, and their sketches both as to position and structure were with one slight exception remarkably coincident. From the time of my first pointing the spectroscope to the bursting out of the sun's light, I never once withdrew my eye, though it was my intention to have shifted the prism cap to the telescope of the theodolite as soon as I should have carefully noted the spectrum of the flames, but while I was intently gazing on the two bright bands to impress their color well on my memory, the new spectrum of the moon's edge appeared, so that I was under the impression that the length of the time of observation was very short. On the other hand, Captain Tanner, judging from the amount of work he did in the time, estimated it at a minute. Mr. Kero Luximon estimated it at 40 or 45 seconds. Immediately after totality, we all three made rough notes of our observations, and Captain Tanner and Mr. Kero Luximon's notes agree together wonderfully in their description of the structure of the flames.

The following is an extract from Captain Tanner's notes made almost immediately after the eclipse :—

"I at first saw three prominences, one long, curved, pointed tongue, and two close together, straight but flat topped, about two-thirds the height of the former. They were of a rose madder color, and were decidedly more like flames than anything else, not only in their general appearance and color, but by their being composed of smaller tongues of flames parallel (or nearly so) to the general axis of the flame, so that they had a streaky appearance and a ragged edge. At first glance, when the sun was somewhat obscured by clouds, I thought that they were homogeneous and had hard edges, but this idea was at once dispelled when the clouds cleared off. The two protuberances which were close together were not, as far as I could see, joined by any smaller shots of flame. I afterwards observed one small protuberance, and marked the position of it in my sketch. I did not observe that it was streaky as the others were, perhaps on account of its being so small, and, perhaps, because I had not sufficient time to examine it properly. As regards the corona, when we just began to see the eclipse through the clouds, I was under the impression that the eclipse, instead of being total, was only annular; so bright was the corona near the moon's limbs. I could not detect any irregularities in the structure of the corona, but the light appeared to be gradually shaded off all round."

CAPTAIN BRANFILL'S DEMI-OFFICIAL REPORT.

We had a beautifully fine morning, but sometime before totality, a film of cirro-stratus spread overhead, and cumuli appeared in several quarters, enough to increase our anxiety and nervousness to a terrible pitch. Tennant had not slept for many nights except in fitful snatches. However, watching the progress of the earlier phases exercised a calming influence. Everything was ready on our part to do our best. I had no recorder, and think I must have lost at least a minute in recording my observations by lamp light. I had noticed and recorded the very serrated edge of the moon, and also the occasional blunting and cutting off of the cusps, both new facts to me, and at first sight rather unaccountable. I had also noticed a very peculiar but distinct line of light, apparently upon the moon's surface, as if in continuation of the cusps—perhaps it was caused by the telescope.

I had watched for the first appearance of the moon's limb against a lighter back ground outside the sun, but only caught sight of it a few minutes before totality. I was watching the formation of bright beads and bugles at the S. cusp of the de-crescent sun, when suddenly, some seconds (15 or more I should think) before totality, I saw plainly a group of red flames—a gorgeous spectacle, and also a wonderful horn-like prominence. Hearing the general shout of the town's folk and fancying totality must be on the point of commencing, I removed the pale dark glass I was using, but too soon, for I could not bear to look on the last of the disappearing sun. It was only for a second, for on taking a second glance I found no sun left: only a splendid group of rose-colored flames and that horn, backed by a bright field of light of various intensity. I took one look and received an indelible impression

of the scene, and then set to work in earnest. With the finder I directed to the brightest part of the corona (the south-east quarter), and examined its light carefully with the Nicoll's prism and crossed quarts, which gave brilliant light, dark, and colored bands, (Savart's). I noted the position of the maximum white band, and the points of disappearance on each side. It was directly clear to me by several trials that the corona was plentifully polarized in all the plane passing through the sun's centre. The double image prism gave the same results as the plain Nicoll. The polarized light was most where the corona was brightest, least where faintest. Satisfied of this, I turned to examine the light of the horn-like red flame; the corona seemed fainter behind it; but though I contracted my field, I of course could not quite exclude all corona light. I could not detect the presence of polarized light on the red flames. With the double image prism, the flame did not seem to vary in tint at all, although with the Savart I could not get rid of bands altogether, and I noticed that, though extremely faint, the bands were continued upon the moon's surface. I was still straining to see and note any difference in brilliancy with the plain Nicoll, when a flood of light in the field told me that all was over, to my intense disgust and disappointment. I was in despair at first, thinking I had done little or nothing, and that perhaps useless; still unheeding everything else, I went on writing down what I had seen, and it gradually came over me that I had seen and noted all that the prisms showed, as well as I could, and could only do the same again.

EXTRACT FROM THE NARRATIVE REPORT OF CAPTAIN J. P. BASEVI, R. E., SURVEYOR, 1ST GRADE, IN CHARGE NO. 4 EXTRA PARTY, NO. 58, DATED 10TH AUGUST 1868.

Experiments at Chiculdah on the correction to a thermometer on account of reduction of atmospheric pressure.

(2). During August and September 1867, I made some experiments at Chiculdah on the correction due to the readings of a thermometer on account of the diminution of the pressure on its bulb when placed in an exhausted receiver. For the purpose of determining this correction I had been supplied with a thermometer hermetically enclosed in a glass tube, whose readings would of course be unaffected by change of pressure. This is placed in a receiver alongside of the thermometers to be experimented on, and the difference of its readings before and after the exhaustion indicates the true change in the temperature of the receiver; so that the difference between the above differences and those shown by the other thermometers is the effect of the diminution of pressure on them.

Reason of similar Mussoorie observations failing.

(3). When at Mussoorie in the year 1865, I took some observations for this same purpose, using a small air-pump and receiver borrowed from the Roorkee Civil Engeering College, but obtained very unsatisfactory results, owing, partly, perhaps, to the smallness of the receiver, but chiefly to my not allowing a sufficient interval of time to elapse after pumping out the air. For the process of exhausting *lowers* the temperature, and on the contrary when the air is re-admitted, the temperature of the receiver is *raised* by an amount equal to that by which it had been previously lowered. The ordinary thermometers

rapidly assume the temperature of the receiver, but the* hermetically sealed one requires very much more time so that unless a considerable time is allowed to elapse, the effect of diminution of pressure on the bulb of the thermometer is mixed up with the effects due to the exhaustion of the air.

Results at Chiculdah.

(4). In my observations at Chiculdah, I used the large receiver in which the pendulums are swung, and after exhausting always allowed a long time. generally as much as 24 hours, to elapse before reading the thermometers. The results are as follows :—

No. of observations.	Pressure in inches.	Corrections.			Remarks.
		No. 714.	No. 715.	Mean.	
		″ °	°	°	
3	1·8	+ 0·31	+ 0·27	+ 0·29	Average atmospheric pressure at Chiculdah 26·2 inches.
6	4·4	·24	·25	·25	
7	7·8	·20	·21	·21	
6	12·8	·11	·12	·12	

This correction most probably depends on the form of the bulb.†

Arrangements for Field Season, 1867-68.

(5). The party, consisting of Mr. W. M. Lemarchand and Mr. J. W. Macdougall, both Sub-Assistants, 3rd Grade, took the field on the 11th October, leaving Chiculdah on that date and Ellichpore on the 16th of October.

(6). From Budnaira I detached both my assistants, Mr. Lemarchand marching ahead to prepare the observatory at Somtana H. S. near Nandair in Hyderabad territory, and Mr. Macdougall went by rail *viâ* Sholapore to Damargida near Beder to get that observatory ready, he was directed to await there further orders from me, my intention being to recall him to the main party or send him further ahead according to the progress made by Mr. Lemarchand. I myself marched to Badgaon, 16 miles from Budnaira, where the observatory had been built last season. During Mr. Macdougall's absence my wife recorded for me, but all computations made in the books have been of course since examined.

Delayed at Badgaon H. S. clock out of order.

(7). I experienced much delay at Badgaon in consequence of the bad going of the clock shelton, and had to reject several days' observations and replace them by others, so that although I

* When testing the freezing points the hermetically sealed one requires at least one hour's immersion in the ice, whilst the others fall to 32° in a quarter of the time.

† General Sabine (Phil. Trans., 1829) obtained a correction of 0·7 of a degree for one thermometer, and as much as 1° for another which had a bulb of unusually large diameter. In the preliminary Pendulum Observations at Kew, the correction to thermometers Nos. 712 and 714 was found to be + 0°·43 from one experiment only.

commenced work on the 25th October, the observations were not completed until the 16th of November.

Magnetic observations at Bombay on H. I.

(8). I now, in accordance with your instructions, went down to Bombay for the purpose of taking magnetic observations at the Government observatory, and so comparing my results with theirs. I reached Bombay on the 19th November and took observations for horizontal intensity on the 22nd and 23rd, my results are—

22nd	November	8·0768
22nd	„	8·0618
23rd	„	8·0649
Mean		8·0678

The mean of two observations taken at the Observatory on the 20th November (provisionally reduced) was—

8·068

which almost exactly agrees with my own determination.

Determination of specific gravities of pendulums at Bombay mint.

(9). I also when in Bombay took my two pendulums to the mint for the purpose of determining their specific gravities. A tin trough was made up for me, capable of receiving the pendulum, which was placed above one scale pan of the balance, being supported independently from the ground on boxes; each pendulum was suspended by wire inside the trough and weighed water was then poured into the trough until the pendulum was completely immersed and its weight again taken. I noted the length of the wire not immersed and measured, and weighed the wire. The water used was Vehar water taken from a large reservoir in the mint. A short time before weighing I weighed by means of a specific gravity bottle equal volumes of the Vehar water and distilled water, noting the temperatures. In all these measurements one of the officers of the mint most kindly assisted me. The results are—

No. 4 *Pendulum.*

Results. Weight in air 95,536·4 grains specific gravity 8·023

No. 1821 *Pendulum.*

Weight in air 91,723·4 grains specific gravity 7·929 at temperature 81° F. compared with distilled water at 390°2 F.

Remarks on the smallness of the results.

(10). These specific gravities are both, I believe, unusually small for brass, and I intend, if opportunity offers, to repeat the determination; at the same time I have no other reason for suspecting their accuracy, and the only omission that I can think of was the neglecting to note the temperature of the water at the time of weighing. As, however, the water was taken from a *large* reservoir and its temperature was observed a short time before, there cannot be an uncertainty about the temperature sufficient to produce any very appreciable effect on the specific gravities.

Thermometers tested in ice.

(11). I also in Bombay procured some ice and tested the freezing points of my thermometers. I left Bombay on the 23rd of November and reached Budnaira on the 24th, and at once marched for Somtana.

(12). Observations were commenced at Somtana on the 20th December, and completed on the 4th January. The going of the clock here was excellent, and I am disposed to attribute its bad behaviour at Badgaon to the presence of a small brass clamping nut which I had attached to the adjusting screw of the pendulum in order to preserve an invariable length. I had never used this nut prior to Badgaon, and I removed it before commencing operations at Somtana. It is difficult to conceive how it affected the regularity of the clock's rate but I can see no other explanation.

Somtana.

Explanation of the bad going of the clock at Badgaon.

(13). I marched from Somtana to Damargida and commenced observations there on the 22nd January. At this station in compliance with a suggestion made by yourself I took a "set" with each pendulum in a *falling* temperature, the "set" commencing at about 8 o'clock P. M., and lasting until about 5 o'clock A. M. The object of these observations was to ascertain whether the temperature of the pendulum *lagged* behind the temperature of the air to any appreciable extent. The thermometers on the dummy pendulum are not in contact with it, and so only record the temperature of the *air* inside the vacuum cylinder. If therefore any lagging exists, in a rising temperature the pendulum will be always behind the temperature shown by the thermometers, consequently too high a temperature will be imputed to it, and the number of vibrations will be *apparently* in excess. In a *falling* temperature the converse will hold, the temperature of the pendulum will be *above* the thermometer readings and the vibrations will be *apparently* in defect. The results obtained are as follows:—

Damargida.

Observations to determine the amount of "lagging."

		Vibrations.		
Pendulum No. 4.	Rising temperature	86,036·902	Range	70° to 76°
	Falling „	36·437	„	76 „ 70
	Mean	86,036·670		

Results. In a {Rising / Falling} temperature, vibrations are 0·232 {in excess / in defect.

Dividing by 0·486 the temperature co-efficient the amount of lagging = 0°·48 F.

		Vibrations.		
Pendulum No. 1821.	Rising temperature	85,935·474	Range	69° to 74°
	Falling „	35·127	„	74 „ 69
	Mean	85,935·300		

In a {Rising / Falling} temperature, vibrations are 0·174 {in excess / in defect.

Dividing by 0·470 the temperature co-efficient the amount of lagging is found to be = 0°·37 F.

(14). These observations, though of course too few to be conclusive as to be *amount* of the lagging, still I think establish the existence of it, and show the necessity of taking it into account. For since the duration of each "set" is constant, it is obvious that the amount of the lagging must vary with the range of temperature, and consequently observations at different stations are not strictly comparable unless the range is the same. It would have been undoubtedly better to have so observed that the effect of lagging should cancel at each station, but now the only thing to be done is to take special

Observations not sufficient to be conclusive, but show the necessity of further examination.

observations in order to correct for it, for it would necessitate the adoption of a new system of observation which would be on many grounds objectionable.

Kota Kodungul. Magnetic observations taken at *Secunderabad.*

(15). Observations were completed at Damargida on the 1st of February, and, having spare time the Kota Kodungul observatory being only just completed, I marched first to Secunderabad, where I took a set of magnetic observations and also again tested my thermometers in ice, not having been quite satisfied with my Bombay results. I reached Kodungul on the 23rd February where I was joined by Mr. Macdougall.

Magnetic observations taken at *Kurnool Namthabad.*

(16). I finished off at Kodungul on the 10th March and marched *viâ* Kurnool, where I took magnetic observations, to Namthabad station close to Gootty and one of Colonel Lambton's latitude stations. Observations were completed here on the 15th April when I proceeded by dâk and rail in advance of my camp to Bangalore, leaving it to follow in charge of Mr. Macdougall by the regular marches. It arrived on the 30th April.

Return to quarters.

Out-turn of work.

(17). The field season's work comprises pendulum and magnetic observations at five stations, *viz.*, Badgaon, Somtana, Damargida, Kota Kodungul, Namthabad, and magnetic observations at these and four other places, *viz.*, Chiculdah, Bombay, Secunderabad, Kurnool.

Mr. W. M. Lemarchand.

(18). I have now to report on my assistants. Mr. W. M. Lemarchand prepared the observatories of Somtana, Kota Kodungul, and Namthabad, and made a rough survey of the Somtana hill. On the completion of the last station, having been offered the appointment of Local Fund Engineer at Ellichpore, he resigned his appointment in the survey, and was allowed to proceed to take up his new one in anticipation of the sanction of Government. He is a great loss to my party in which he had done very good work.

Mr. J. W. Macdougall.

(19). Mr. J. W. Macdougall, as already stated, prepared the Damargida observatory for me, and afterwards partly assisted Mr. Lemarchand in building the one at Kodungul; he recorded for me at Kodungul and Namthabad, and brought up all the arrears of computations which had accumulated during his absence from the main party. I have no reason to alter the favorable opinion I expressed last year of Mr. Macdougall, he is a valuable assistant and well up in all the computations.

Probable errors given in Appendix III.

(21). In Appendix III is given a table of the probable errors of the various kinds which are susceptible of calculation for each station from the commencement. The *mean* results from 15 stations are—

TRANSIT OBSERVATIONS.

		s.			
Probable errors of star's transit over one wire	= ±	0·092	Extremes ± ·141	and ± ·061
Probable error of mean of 5 wires	= ±	0·041	„ ± ·063	and ± ·027
Probable error of clock rate deduced from 6 stars,	= ±	0·031	„ ± ·051	and ± ·016

PENDULUM OBSERVATIONS.

	No. 4.	No. 1821.
Probable error of observation of one coincidence	$= \pm 0^{s}\cdot472$	$\pm 0^{s}\cdot472$
Deduced probable error of vibrations per diem	$= \pm 0^{v}\cdot026$	$\pm 0^{v}\cdot029$

COMPUTED FROM RESULTS.

	No. 4.	No. 1821.
Probable error of one "set" at a station	$= \pm 0^{v}\cdot167$	$\pm 0^{v}\cdot149$
Probable error of result at a station	$= \pm 0^{v}\cdot058$	$\pm 0^{v}\cdot054$

(23). During the last two seasons I have kept a register of the readings of an aneroid barometer at all places that I have visited. Appendix VIII gives the results of these observations from Meerut to Bangalore. They are computed by Table XVIII of Boileau's tables, the observed heights being the difference of the tabular numbers due to 30·00 inches and to the observed barometer reading. A mean correction is obtained from the difference between the thus computed and the trigonometrical or spirit levelling heights of two stations including the other stations. For instance, the correction for stations between Somtana and Damargida is obtained from the mean difference between the computed and trigonometrical values of these two stations.

Barometric heights of stations *en-route* between Meerut and Bangalore.

(24). I have already alluded to the necessity of taking observations to determine the effect of "lagging;" there is another subject of equal importance to which my attention was also directed by yourself. It has been shown that the temperature of the pendulum lags behind the readings of the thermometer; but besides this effect and after making due allowance for it, it is probable that the thermometers will still not give the true *mean* temperature of the pendulum; for the thermometers have been placed on the dummy pendulum at two points equidistant from the ends of the bar and from each other, so as to give the temperature of the bar, but not the mean temperature of the whole pendulum. Were the pendulum *at rest* its mean temperature would be found by the formula

On the mean temperature of a pendulum.

$$T = \frac{m_1 t_1 + m_2 t_2 + m_3 t_3}{m_1 + m_2 + m_3}$$

where m_1 m_2 m_3 denote the masses of the bar, bob and tailpiece, and t_1 t_2 t_3 are their respective temperatures. When however the pendulum is in motion, its *mean* temperature is that which, if common to the whole pendulum, would cause its vibrations to be performed in the same time. Supposing the pendulum homogeneous it can be shown that the true mean temperature which may be called "mean *vibrating* temperature" is given by the formula

Mean "vibrating" temperature defined and formula.

$$T_v = \frac{2 \cdot \Sigma [m k^2 T]}{\Sigma [m k^2]} - \frac{\Sigma [m a T]}{\Sigma [m a]}$$

where $m k^2$ denotes the moment of inertia of one of the masses (m) of which the pendulum is composed, T the temperature of k its radius of gyration, and a the distance of its centre of gravity from the axis. Applying this formula to the pendulums in use whose dimensions are very nearly the same, I find

Application to Indian pendulums.

$$T = 0{\cdot}91\, t_1 + 0{\cdot}08\, t_2 + 0{\cdot}01 t_3$$

where t_1 t_2 t_3 are the temperatures of the bar, bob and tailpiece respectively, so that the thermometers are in a very favorable position for determining the true mean vibrating temperature, unless the differences of temperature between the bob and upper bar are large which is not likely to be the case in practice. The proof of the preceding formula is given in Appendix IX, it is, I believe, a new way, but at the same time the most theoretically correct way of determining the mean temperature of a pendulum.

Result. That the thermometers as placed give the mean vibrating temperature with sufficient approximation.

ON THE MEAN VIBRATING TEMPERATURE OF A PENDULUM.

Suppose the pendulum to be homogeneous and to consist of the several masses m_1 m_2 . . . m_u whose centres of gravity are distant a_1 a_2 . . . a_u from the axis of suspension, their mean temperatures t_1 t_2 . . . t_u and moments of inertia at the zero from which the above temperatures are measured $m_1 k_1^2$, $m_2 k_2^2$ . . . $m_u k_u^2$.

Then the length of the corresponding simple pendulum at that temperature.

$$l = \frac{\Sigma [m k^2]}{\Sigma [m a]}$$

Let T_1 T_2 . . . T_u be the temperatures of k_1 k_2 . . . k_u which may be supposed to hold also for a_1 a_2 . . . a_u then the length of the simple pendulum will be

$$l' = \frac{\Sigma [m k^2 (1 + 2f T)]}{\Sigma [m a (1 + f T)]} = \frac{\Sigma [m k^2] + 2f \Sigma [m k^2 T]}{\Sigma [m a] + f \Sigma [m a T]}$$

where f is the factor of expansion of the metal of which the pendulum is composed, the second powers of which are neglected.

Again if $\mathbf{T}$ = mean vibrating temperature we must have—

$$l' = \frac{\Sigma [m k^2] (1 + 2f T)}{\Sigma [m a] (1 + f T} = \frac{\Sigma [m k^2] + 2f T \Sigma [m k^2]}{\Sigma [m a] + f T \Sigma [m a]}$$

whence

$$\Sigma [m a] \Sigma [m k^2] + 2f \Sigma [m a] \Sigma [m k T] + f T \Sigma [m a] \Sigma [m k^2] = \Sigma [m a] \Sigma [m k^2] + f \Sigma [m k^2] \Sigma [m a T] + 2f T \Sigma [m a] \Sigma [m k^2]$$

or

$$\mathbf{T} = 2 \frac{\Sigma [m k^2 T]}{\Sigma [m k^2]} - \frac{\Sigma [m a T]}{\Sigma [m a]}$$

Applying this result to the pendulums whose dimensions are so nearly the same that the values of $\mathbf{T}$ obtained for one will hold good for the other—

Bar	—	$m_1 k_1^2$	=	3,880	$m_1 a_1$	=	154	k_1	=	18·8	a_1 = 14·0
Bob	—	$m_2 k_2^2$	=	54,635	$m_2 a_2$	=	1,352	k_2	=	40·4	a_2 = 40·3
Tailpiece	—	$m_3 k_3^2$	=	2,990	$m_3 a_3$	=	61	k_3	=	49·4	a_3 = 49·0
		$\Sigma [m k^2]$	=	61,505	$\Sigma [m a]$	=	1,567				

whence we get

$$\mathbf{T} = \cdot 03\, T_1 + \cdot 91\, T_2 + \cdot 06\, T_3$$

But assuming the temperatures t_1 t_2 t_3 of the bar, bob, and tailpiece to hold good for their respective lengths we find

$$T_1 = t_1; \quad T_2 = \frac{37}{40} t_1 + \frac{3}{40} t_2; \quad T_3 = \frac{37}{49} t_1 + \frac{6}{49} t_2 + \frac{6}{49} t_3$$

whence finally

$$\mathbf{T} = 0{\cdot}91\, t_1 + 0{\cdot}08\, t_2 + 0{\cdot}01\, t_3.$$

NARRATIVE REPORT OF THE TRANS-HIMALAYAN EXPLORATIONS MADE DURING 1867, DRAWN UP BY CAPTAIN T. G. MONTGOMERIE, R. E., OF THE G. T. SURVEY, FROM THE ORIGINAL JOURNALS, &c., OF THE TRANS-HIMALAYAN EXPLORING PARTIES.

The Trans-Himalayan explorations made during 1865-66 from the Mansarowar lake to Lhasa supplied various pieces of information as to routes and places in Tibet of which the names were unknown in India. Tibetans had been heard to talk of their gold mines and salt mines, and the position of some of the latter was indicated roughly on European maps, but our knowledge of all such places was vague in the extreme, though the Tibetans certainly do bring both gold and salt. The 1st Pundit heard of these places whilst in Lhasa, and the 2nd Pundit when at the Gartok fair heard various particulars, from which he gathered that the route to those gold fields east of Gartok was likely to be feasible.

It will be remembered that the 2nd Pundit made his way to Gartok in 1865 by one route and returned by another, thus connecting that place with points in British territory on the south that had been fixed by regular survey. There however still remained a large gap between Gartok and the Ladak territory, which latter had also been surveyed. It appeared to me very desirable that this gap should be filled up, the more especially as it embraced a portion of what was said to be the course of the great river Indus, a portion moreover that had never been traversed by any European.

The information I received during the prosecution of the survey of Ladak as to the Indus, lead me to think that there was a large eastern branch of that river, and I was confirmed in that opinion by the reports of the Surveyors who sketched the extreme south-east of Ladak.

Owing to the great jealousy of the Tibetans the Surveyors could not make their way very far beyond the frontier, the fact of their being engaged on the survey of Ladak arousing the suspicions of the Tartars so much that a regular watch was established the moment a Surveyor approached the frontier. Nevertheless the ground was sketched to some distance beyond, and peaks were fixed at a still farther distance by the theodolite.

The natives pointed out the position where the eastern branch came in, and a gap seen in the mountains in that direction made its existence highly probable. Having this information it seemed to me very desirable that the question as to the existence or non-existence of this branch should be settled. I consequently determined that the 2nd expedition of the Pundits should be in that direction, the first object being to settle various doubtful points as to the positions of the upper basin of the Sutlej; the 2nd object, the question of the eastern branch of the Indus; the 3rd, the connection of Gartok with the regular survey in Ladak; and the 4th to explore up to the gold and salt mines east of Gartok and as far beyond as the Pundits could get in an easterly direction. The latter being with a view to gain some knowledge of the vast *terra incognita* lying between the desert of Gobi and Lhasa.

Preparations for the expedition were made during the spring of 1867, a 3rd Pundit was entertained and trained to supplement the place of the 2nd Pundit who had proved to be somewhat wanting in nerve. Starting from Mussoorie on the 2nd of May, the party under the

1st Pundit reached Badrinath on the 24th of May and Mana on the 3rd June. The Mana pass to the north had not been declared open; and the party had consequently to wait at Mana. Whilst there several heavy falls of snow occurred on the neighbouring mountains.

The Pundit found that before his party could cross into Tibet it was necessary that the opening of the pass should be formally notified by the Tibetan officials, and before this is done the Jongpon (or Zungpung) of Chuprang makes inquiry every year as to the political and sanatory condition of Hindustan. The inquiry seems to be carried out with all that assumption of lofty superiority for which Chinese officials are famous. Looking down from their elevated plateaux they decide as to whether Hindustan is a fit country to have intercourse with. The decision come to appears not to be at all a dead letter, for as will be seen hereafter it ultimately affected the Pundits' movements not a little. The especial enquiries are made as to whether there is war, epidemic, famine, &c., such as are in any way likely to affect Tibet.

During his stay at Mana the Pundit made complete arrangements for their journey, and he gave the 3rd Pundit some farther practice in route surveying. Whilst there he was also fortunate enough to secure the services of three men, *viz.*, of a Bisáhiri trader, a resident of Badrinath and a Ladaki trader from Zaskar. All these men knew the routes to the gold and salt mines east of Gartok. They proved moreover exceedingly useful in collecting provisions, servants and asses, the latter for the carriage of the small parcels of merchandize which formed the ostensible object of their journey. On the whole the halt at Mana was a decided gain to the party.

At length on the 9th of July three men sent by the Jongpon of Chuprang arrived and having made all their inquiries declared the Mana pass open to traders from Gurhwal; the party accordingly was able to commence its march on the 26th July. It consisted of 11 men, 12 asses, and one poney, the men being all armed with weapons they had borrowed at Badrinath, as they were told that arms would be required to keep off robbers. On the 28th they crossed the Himalayas by the Mana pass (18,570 feet) and on the 29th July reached Lumarti Camp. Here they were told to halt until more traders joined them, so that the Tibetan officials might be saved trouble by examining and taxing a number at the same time. The 2nd Pundit, however, was sent on ahead to intercede with the Chuprang Jongpon, and he succeeded in getting authority for the party to advance alone. Churkong is the place where traders are generally taxed, but in this instance the examination was made at Barku. The Abtuk of Chuprang searched the baggage fortunately without discovering the instruments and being satisfied that the party was a trading one he levied the taxes at the usual rates.

On the 6th August the party reached Totling, passing the small town of Chuprang on their left (north).

At Totling they put up in the monastery, the Monks (Gelongs or Dabas) allowing all travellers to do so. The monastery with its numerous dykes of stones is about one mile in circumference, it has 50 to 60 Monks attached to it, the head one bearing the title of Ling-Khambo.

Between Mana and Totling there is no cultivation of any kind, but at Totling itself a grain called nai (barley) is sown in April and reaped in September.

From Totling the party advanced direct towards Gartok, crossing the Sutlej by a remarkable iron suspension bridge, 76 feet span, 7 feet wide, and about 40 feet above the water. The chains are formed by links of iron of the shape of the figure 8, each about one foot in length, the iron being over one inch square. The bridge is said to have been built by Gyalpo Kesar or Sekundar Badshah (Alexander the Great)! The iron is in capital preservation owing to the very small rainfall, and to the care with which it is annually lubricated with butter (ghee.)

After crossing the Sutlej the Pundit and his party all assumed the costume worn by Bisáhiri traders.

On the 9th August they crossed the watershed between the Sutlej and the Indus by the Bogola pass 19,220 feet above the sea, and reached Gugti camp close to Gartok on the 11th instant, avoiding the latter place, lest its officials should in any way interfere with their onward progress. Continuing their journey they ascended the mountains east of Gartok, and after crossing the Gugtila pass 19,500 feet above the sea, they found themselves on the 14th August in a vast desolate plateau, the lowest points of which they ascertained to be 15,280 feet above the sea.

This plateau is called Chojothol or Antelope plain, from the great number of those animals seen on it.

On the 16th they reached a small lake covered with ducks and other wild fowl. On a head no signs of a path or of either houses or tents were to be seen, and the party became anxious as to fresh water which was said to be very scarce. It was not till the evening of the 2nd day that they came upon fresh water.

Several very brackish lakes were passed, so intensely salt that even the wild fowl avoided them. No potable water could be got till they found a glacier and melted its ice.

On the 10th they crossed the Pabha-la 17,650 feet above the sea, and descended to the Giachuruff camp on the banks of the Singh-gi-chu or Indus river 15,730 feet. After the desolate and arid table-land they had crossed, the sight of the river and its fresh water, and of the large camp beyond was at first very pleasant to the Pundit's party; their pleasure was however soon damped as they found the inhabitants of the camp very suspicious as to the object of their journey. Their progress being for the first time impeded by the officials. Gopa Tajam the head man questioned them as to the objects of their journey and as to who and what they were, &c. When told that they were Bisáhiris who had come there solely to sell coral and purchase shawl wool (pushm) in exchange, he told them flatly that he did not believe their story. With great correctness he then proceeded to point out the proper country of each individual, and said that if they had been really all Bisáhiris and had been lately in Bisáhir, they would never have dared to enter Nari Khorsum that year, as an order had been promulgated at the time of opening the passes, forbidding Bisáhiris to enter the country on any account, as they had in the previous year introduced small-pox, which proved fatal to many of the

inhabitants. The head man moreover hinted that the party had introduced Europeans into the country.

These suspicions being so strongly expressed, alarmed the Pundits, more especially as they never thought that the disguise of a Bisáhiri, which had served them so well on the route to Lhasa, would prove a hindrance on this occasion.

The Pundit thought these suspicions were due to the jealousy of an acquaintance of his who lived near Badrinath. However by repeated protestations he managed to bring the head man round to a partial belief in their story, so that he at last consented to allow a portion of the party to proceed onwards, provided the remaining portion was left as a hostage for their good faith.

As the 2nd Pundit's nerves were again considerably shaken by the dreary mountains they had crossed and by the check they had received, the 1st Pundit decided to leave him at Giachuruff, whilst he and the 3rd Pundit pushed on ahead on the pretence of selling their coral.

Whilst preparations for this purpose were being made, the head man's suspicions began to gather again and it was only after farther entreaties, accompanied by presents, that they were allowed to advance. The Pundit left the Giachuruff camp on the 22nd August with the 3rd Pundit; but the latter was very soon after starting detached with one servant to carry a route-survey up to the river Indus as far as he could get.

The Pundit himself made very long march, so as to get well clear of the Giachuruff people, and by night was far away to the east resting near the bed of a small dry stream. On the 23rd August he hoped to have been able to cross the Chomorang range, but owing to a very heavy fall of snow, he was obliged to halt at a camping place below it. Snow continued to fall on the 24th and 25th, and he was not able to continue his march till the 26th August, when he crossed the Chomorang-la pass 18,760 feet above the sea and after a very long march, crossing a good deal of snow, he reached the large camp of Thok-Jalung,* the chief gold field of that part of the country.

As the Pundit descended the Chomorang-la pass the Thok-Jalung camp came in sight, he found it pitched in a large desolate plain of which the prevailing color was reddish brown. As far as he could see, it at first appeared to be like other Tibetan standing camps, except that it was very much larger. As he got closer he made out the noise of a great number of voices singing together, and on his arrival found that this came from the gold diggers and their families whilst the men were at work.

The Pundit had armed himself with a letter from the Giachuruff Chief, and this he presented the next day to the Thok-Jalung Chief, with a small present of the best Indian tobacco, which he had somehow discovered to be a particular weakness of that individual.

The Chief received the Pundit in his large tent, he was much gratified by the present, but in spite of that and the letter it was evident from his manner that he did not think that matters were quite right. He cross-questioned the Pundit, and then advised him to do what he had to do in Thok-Jalung quickly and to return to Giachuruff by the same road as he

* Thok-Jalung Latitude N. 32° 24' 26·5, Longitude 81° 37' 38".

came. The Chief said that it was out of his power to allow the Pundit to stay long, and that properly he ought to have sent him back at once, as there was an order in force forbiding all Bisáhiris to enter the country that year.

Hearing that the Pundit had coral for sale he asked to see it. As soon it was displayed the Chief's wife, who was present, took such a liking to it that she persuaded the Chief to offer gold in exchange, the Pundit thought his only chance was to acquiesce and he did so, making as he afterwards found out, a very bad bargain. Having given up his coral, the Pundit was allowed to retire.

The Chief was an inhabitant of Lhasa called Yoodak Mingmár, about 45 years of age. He had been master of the Thok-Jalung gold field* for some time. The Pundit saw him several times afterwards and always found him very civil. His usual dress was a red robe of Lhasa or Shigatze manufacture, his head was covered with a brown felt hat of Chinese fashion with a broad rim turned up all round. He told the Pundit that he and every one else wore furs in the winter, and that they could not live at that season without them, which is no doubt correct, as the Pundit's observations make the gold field to be at the great altitude of 16,330 feet above the sea. His tent was a large circular one about 5 feet in diameter with two poles, it was pitched in a wide pit some 7 or 8 feet below the surface of the ground, and the descent to it was by means of steps. Outside, the Pundit noticed one of the gigantic black dogs of Lhasa, this beast was tied unpleasantly near the door and was so savage that there was great difficulty in preventing him from flying on strangers. The Pundit had seen many of these dogs in Lhasa, and he at once recognized it by its great size, deep jowels, and the white mark on its chest. The Lhasa people call them Gya-ki or royal dogs.

The tent was made of black yaks' hair, it contained bales of shawl wool (pushm), leather packages of tea, strings of dried beef from the yak and a few other Tibetan luxuries, such as dried apricots, currants, &c., the poles were garnished with several matchlocks and a sword. The Chief's seat was besides a small box in which there was a drawer containing paper, pen, ink and couple of cups or bowls, one for drinking tea and the other for Chung or whiskey. The Chief's tent seems to have also been the shrine of the camp as behind his seat there were piled up the usual images, small brass bells, tiny vases, books, pictures†, lights, &c., that are carried about by wandering Budhist Lamas. Whether the Chief was also a Lama was not ascertained, but his red dress and the ritualistic instruments point to that conclusion.

The Chief was constantly smoking a silver-mounted Nepalese Hookah. Tea was forthcoming at all hours. He had about ten personal servants who lived in small tents round about his own. The Chief was a very intelligent man and all things considered the Pundit thought him well informed. His shrewdness there was no mistaking as instanced in the matter of the coral. He noticed the Pundit's box, examined it carefully

* From previous information it appears that gold was first discovered to be abundant at Thok-Jalung about eight or nine years ago.

† Quaintly painted on cloth, many of that kind can be seen in Ladak at the Hemis and other monasteries.

and then asked him how he came to have such a good box. The Pundit was fortunately ready with his answer and said he bought it at one of the 'Saheb logues' auctions to carry his coral in. The fame of these auctions had reached even this Tibetan Chief, and he expressed himself as quite satisfied, allowing the box to be removed without discovering the large sextant which was stowed away in a secret compartment. The Chief took a great liking to the Pundit and used to send for him every now and then in order to discuss over tea and tobacco the great country down below.

The Pundit found the part of the gold field that was being worked to be a great excavation from 10 to 200 paces in width and some 25 feet in depth, access to the bottom being by means of steps and slopes the earth as dug out being thrown upon either side. The excavation at the time of the Pundit's visit was about a mile in length.

The digging is carried on with a long handled kind of spade and occasionally with an iron hoe, the iron for these implements is brought from Bisáhir, Ladak, &c. The camp had a blacksmith who could repair these tools.

A very small stream runs through the gold field and the bottom of the excavation is consequently rather a quagmire during the day time; but the stream is put to good use for washing the gold out of the soil. The diggers dam up the water and leave a sloping channel for it to escape by. A cloth is spread at the bottom of the channel and kept down by number of stones as to make the bottom uneven. One man brings earth from the excavation and sprinkles it over the channel, whilst another man drives water down the channel by means of a leather bag. The water carries the lighter soil right away, but the pieces of gold fall into the uneven places and are easily collected in the cloth by lifting up the stones. The yield of gold seems to be large and the finds occasionally very heavy—the Pundit saw one nugget of about 2 lbs. weight (75 tolahs). The diggers say they can recognize the soil that contains gold at once, but judging from the large number of gold fields that have been used at one time around Thok-Jalung, and are now more or less abandoned, the Tibetan gold diggers seem to be quite as capricious as those of Australia or California, and the probability is that whenever they are a long time without getting good finds, they strike their Camp and move off to what they think a more tempting field.

From what the Pundit heard during this last expedition and the previous one to Lhasa, there is a whole string of gold fields extending all the way from Lhasa to Rudok, along the route which must run close to the northern water-shed of the Brahmaputra, probably in the depression to the north of it.

The gold fields are carefully watched by the Lhasa Authorities, a gold commissioner, called Sarpon,* superintends the whole of them and each field has a separate master. Any individual is allowed to dig provided he pays the annual tas of one sarahoo weight of gold, which is aboute ½ a tolah or ⅔ths of an ounce. The greater part of the diggers come from the Chung province around Shigatze. The gold commissioner makes an annual tour through the gold district, visiting each field and collecting the taxes.

* Sar is the Tibetan name for gold.

The Pundit says that in all his travels he never experienced such intense cold as he did at Thok-Jalung, owing as he thought to the high cold wind that was always blowing, more than to the great elevation, *viz.*, 16,330 feet above the sea.

The tents of the diggers are always pitched in pits some 7 or 8 feet below the surface of the ground so as to keep out the wind. Spite of the cold the diggers prefer working in the winter; and the number of their tents which in summer amounts to 300, rises to nearly 600 in winter. They prefer the winter as the frozen soil then stands well and is not likely to trouble them much by falling in.

The water near Thok-Jalung is so brackish that the diggers cannot drink it till it has been frozen and then remelted. Considering these difficulties about water, the great elevation, the total absence of wood, and the general severity of the climate, gold digging at Thok-Jalung is carried on under very much greater difficulties than in any other part of the world. Nevertheless the diggers appeared to be cheerful and were constantly singing, their families joining in a sort of chorus, which could be heard at a great distance.

Argols of dried dung from the yaks, ponies and sheep, &c., from the only fuel. The Tibetans cook and eat three times a day, their food consisting chiefly of boiled meat, barley cakes, butter-milk, and tea stewed with butter.

The Pundit said the Tibetans all preferred China tea and did not approve of Himalayan tea spite of its price, they vowed the latter was too heating for them and that only very poor folks take it.

There was no attempt at masonry in the whole camp, the only apology for it being a square churtan of dry stone plastered with white earth and surmounted with a pole and flag.

At the foot of the mountains round about, the diggers had collected 7 or 8 piles of white stones(probably quartz) and on the bare slopes they had also picked out with white stones the letters of the sacred sentence "om mani padmi hom," on such a gigantic scale that it could be read at a great distance. The sentence was repeated in this way over and over again.

The diggers all eat yaks' flesh, and they are said to get over their Tibetan scruples by strangling their tame yaks, but they nevertheless do not object to wild animals, yaks, asses, &c., that have been shot.

The Tibetans say that eating roasted meat impedes their breathing and that fresh milk has the same effect, they consequently forbid both and invariably eat boiled meat, throwing away the water in which it is boiled and drinking butter-milk. They extract their butter (ghee) from the milk of yaks, goats, and sheep. Their tea is invariably stewed with butter. The meal they use is generally barley meal.

The position in which Tibetans sleep is a most extraordinary one, they invariably draw their knees close up to their heads and rest on their knees and elbows, huddling every scrap of clothing they can muster on to their backs. Those who are better off rest in this manner on a sort of mattrass that rises towards the head, and the poorer people in standing camps generally manage to get a suitable slope on the mountain side, or to arrange stones and earth so as to rise in the same way; but rich and poor adopt the same position for sleeping. The Tibetans employed in

Ladak by the Survey, though provided with tents (shouldaries) invariably slept in the way described above, arranging themselves in a circle round the tent. This position is most probably adopted in order to secure as much warmth as possible for the stomach, the thighs pressing against it and thoroughly excluding the external air. The gold diggers smoke a great deal, using brass, zinc or iron pipes, the latter being most common.

The Pundit mixed freely with the gold diggers and observed all their ways and habits, but his time was limited. The Chief spite of his friendly conduct insisting that he could not let him stay beyond the 31st of August.

He ascertained that the price of the gold at Thok-Jalung was only Rs. 5½ to Rs. 6 in silver per saishoo, (which weighs about a half tolah and 8 ruttees), or rather less than Rs. 30 per ounce. There were two tents belonging to goldsmiths in the camp, they came from the Chung or Shigatze province.

Seeing no chance of extending his journey to the east of Thok-Jalung, the Pundit retraced his route to Giachuruff, there he found the 3rd Pundit who had made his way for a considerable distance up the river Indus to a place called Jiachan.

Though the 3rd Pundit had heard that a large band of mounted robbers were wandering about the Upper Indus, he was in no way hindered by them till he reached Jiachan.

There, however, whilst he was down at the river, a couple of armed robbers fell upon his servant, an oldish man, and knocked him over, seizing a thermometer and the cocoanut containing the supply of quick silver. Fortunately the Pundit was not far away and hearing the cries he rushed to the rescue, seizing one of the robbers by his pig tail he swung him round and took back the stolen things. This 3rd Pundit being a tall powerful man completely turned the tables and the robbers pretended that they had only been joking with the old man and did not really mean to take anything. The robbers made off as soon as they could, and the 3rd Pundit thinking they might bring down more of their brethren on him, decided to retrace his steps. He was very reluctant to do this, as from all he could hear, 3 or 4 marches more at the outside would have taken him to the source of the Indus, which at the farthest point he visited was still a good sized stream. He was, however, certain that from the peculiar head dress of the robbers that they belonged to the armed band he had been warned against—the head dress being one peculiar to the nomadic inhabitants of the Shellifuk and Majin districts, who are noted as professional robbers.

The whole of the Pundit's party having been re-collected at Giachuruff, he decided to trace the Indus down to its junction with the river upon which Gartok stands. Starting on the 4th September they marched steadily down stream, passing numerous camps with their flocks and herds, but seeing no cultivation or village, till the 7th, when they came to a small village with the first patch of cultivation. All along the banks there was a low bushy jungle. The grass appears to have been abundant, and near one camp there was a herd of 5 or 600 horses or large ponies running almost wild, mostly of a white or a greyish color. On the 12th September they reached the junction of the Indus and Gartok rivers, and crossing the latter encamped near the Lujan-Chumik spring.

From Lujan-Chumik the Pundit sent the 3rd Pundit to trace the river down into the Ladak territory, whilst he traced it up to Gartok. On the 14th September he reached Gar-Gunsa, the winter residence of the Gartok Authorities. He found only 3 large and 8 small houses in it, and was informed that the rest of the inhabitants lived in tents. All along the banks of the river he found the grass tall and luxuriant. The valley all the way up was flat and wide.

On the 16th September the Pundit reached Gartok,* where he found a camp of about 200 tents mostly belonging to traders. On his arrival he was alarmed to find that some one had been spreading reports as to his being in British employment and he found it advisable to hasten his return. Choosing a new route he got separated from his baggage and the greater part of his party, and had he not fallen in with traders from Shipki, he would have been put to very great hardships. He crossed by the Laochia pass and marching by Shiang and Dunkhar, reached Totling on the 26th of September. Here they waited for the 3rd Pundit, who joined them on the 29th of September, after having traced the Indus down to Demchok in Ladak. From Demchok he crossed from the basin of the Indus to that of the Sutlej by a very high pass and carried a route-survey down to Totling. †

From Totling the 2nd and 3rd Pundits were sent down the Sutlej to Shipki, tracing the river as closely as they could. From Shipki they carried a route-survey in a southerly direction crossing the Himalayas by a high pass and descending to Nilung on the upper course of the Ganges.

The Pundit himself returned from Totling to Badrinath by nearly the same route as he advanced by, only making one small variation.

Ultimately the 2nd and 3rd Pundits rejoined the 1st, and they all made their way down into British territory by the beginning of November.

The geographical results of the exploration can be seen at a glance from the accompanying map. They account for the geography of about 18,000 square miles, founded on 850 miles of route-survey with 80 heights. The routes are checked by 190 latitude observations taken at 75 different points.

The course of the Sutlej river has been roughly traced from Totling down to Shipki on the border of British territory. Hitherto there has been no survey of any kind of this portion, and the route though only actually touching the river for a short distance was carried near enough to it to enable the Pundits to lay down its probable course very closely.

The position of Gartok as determined by the two routes of the last expedition has been confirmed by a third route carried up from Badrinath. The mean of three gives a very good longitude of Gartok ‡ as has been proved by the farther route-survey carried from Gartok to Demchok, which latter had been previously fixed by the regular survey operations in Ladak. The longitude by the route-survey only differing from that of the regular survey by 2½ minutes, a very satisfactory result from a

* Gártok is said to be a corruption of Gártod, tod meaning upper, it is also called Gár Yár-Yársá, yársá meaning summer abode, from Yársá summer and sá abode. The winter quarters are called Gár-Gunsá from Gungá winter and sá abode.

† The portion between Medokding and Totling was previously traversed by Captain Henry Strachey.

‡ Gartok Longitude E. 80° 23′ 33″, Latitude N. 31° 44′ 4″, and height 14,250 feet above sea.—T. G. M.

route-survey* traversing 160 miles direct over such a very rough tract of mountains.

The routes have also defined the courses of both the upper branches of the river Indus from near their sources to their junction, and the conjoint stream from that point into Ladak. Neither of these branches had been previously surveyed in any way, except a small portion of the Gartok branch above Gartok which had been roughly laid down by Moorcroft.

The existence of the eastern branch was doubted by many geographers† as no Europeans had ever seen it. The Pundit's route has now proved that this eastern branch is the main stream known to the natives as Singh-gi-Chu or Singh-gi-Khamba (Lion's mouth), the river Indus itself whilst the other branch hitherto generally supposed to have been the main stream is much smaller than the eastern one and invariably called the Garjung-Chu.

The routes extended beyond the eastern watershed of the Indus as far as the great Thok-Jalung or Thok-Samba gold field. Thok-Jalung was moreover roughly connected with various other gold fields and salt mines by means of information derived from travellers, and the general correctness of this information was roughly established by a route to Rudok, derived from similar information which made out the position of that place tolerably close to that determined by the regular survey.

A number of lofty snowy peaks were determined from various stations of the route-survey, the most remarkable being the Aling-Gangri group north of the Indus, which, judging from the great mass of snow seen on the southern face during August, September must be upwards of 23,000 feet above the sea, possibly as much as 24,000 feet.

The line of perpetual snow on the southern slopes of the Ladak mountains approximates to 20,000 feet in the same latitude, and it would require several thousand feet of snow above that line in order to be very imposing at 80 miles, at which distance the Pundit first saw it. The Aling-Gangri group had never as far as I am aware been heard of before. They appear to be a continuation of the range between the Indus and the Pangkong lake. The Pundit could see no farther continuation of the range to the east of Thok-Jalung.

Another high group was seen to the east of the Medok-la, on the watershed between the Sutlej and Indus.

Altogether the Pundit and his brethren have, as I predicted, improved very much in the art of fixing distant peaks, satisfactory proof of this

* The values of the pace as tested by the differences of latitude were very accordant thus :—

	Difference latitude.	Deduced length of pace in feet.	Remarks.
	° ′ ″		
From Badrinath to Gartok ...	0 59 36	2·495	By 1st Pundit.
„ Gartok to Thok-Jalung ...	0 40 23	2·512	„ 1st Pundit.
„ Gartok to Demchok ...	0 57 17	2·634	„ 1st and 3rd Pundits.
„ Demchok to Totling ...	1 13 24	2·495	„ 3rd Pundit.

T. G. M.

† It was indicated from Native information by H. Strachey on his Map of Ladak and Gnair-Khorsum.

has been forthcoming from their back bearings to well known peaks, such as Leo-Porgyal, Kamet, &c., which gave very accurate positions to those peaks, forming at the same time a valuable check on the route-surveys, and proving that there has been no large accumulation of error.

The numerous heights determined by the boiling point give a good idea of the great elevation of the country traversed, and the consequently enormous difficulties under which the route-surveys were made. From them it will be seen that the Pundits were for more than three months at an elevation of over 13,000 feet.

They crossed the great range between the Sutlej and the Indus three times, that between Gartok and Chajothol once, between Chajothol and Giachuruff once, the Chomorang range twice, and the Himalaya range three times, each of the crossings involving a pass of over 17,000 feet, two of them being over 19,000 feet.

The height of Gartok by the above is only 14,250 feet instead of 15,000, as had previously been assigned to it. At the several points, Totling, &c., where Henry Strachey's heights were taken, the Pundit's heights are generally lower. A difference in the same direction was noted in the results of the previous expedition at a point near the Mansarowar lake, and judging from the following comparisons, it appears to arise from a constant difference, probably due to the thermometer employed :—

	By the G. T. Survey.	*By H. Strachey.*
Hanle	14,276 feet	14,500
Pangkong	13,936 „	14,300
Tankse	12,791 „	13,000
Diskit	9,950 „	10,400

The above shows that Captain H. Strachey's were generally higher than the Great Trigonometrical Survey values, by about 300 feet on the average, and the Pundit's values differing from Captain Strachey's by about the same amount, it may be concluded that they are tolerably near the mark, and at any rate not in excess.

The Pundit's heights agree with those of Badrinath as determined by another observer.

During their journey from Mana to Thok-Jalung a total distance of 207 miles, they only met with cultivation once, *viz.*, near Totling on the Sutlej, everywhere else the mountains were too high to allow grain to grow. The mountains, however, produce plenty of coarse grass, sufficient to support large flocks and herds, the Pundit's coming across camps nearly every day.

The weather until they reached the Chomorang range was good; there, however, the fall of snow was very heavy, though it did not extend in any great quantity on the Thok-Jalung side. At Thok-Jalung itself, only a little rain fell, though it was often cloudy.

During the whole of the time* the Pundit was on the Upper Indus, there was a dense bank of clouds in the direction of the Kailas peak, and consequently neither he nor the 3rd Pundit could ever get a bearing to that peak, though they were on the look out to do so.

In spite of the desolate aspect of the mountains traversed, the number of wild animals was remarkable, quantities of Tibetan antelopes,

* The rains were in full progress at this time on the outer Himalayan ranges.

wild asses (kiangs), yaks, grey wolves, hares and marmots. Wild fowl swarmed on some of the small lakes, and ravens used to visit the camp in pairs.

The actual source of the eastern branch or main stream of the Indus was not reached, but the people between Giachuruff and Jiachan said it rose at a place called Gangri-Goorgiap which may perhaps refer to the Gangri or Kailas peak; but the direction of the course of the Indus, as seen from near Jiachan, pointed rather to the east of that mountain. The whole district along the upper course of the Indus is called Bongthol, which is divided into the small districts (puttees) of the Singhtod and Singhmet. "Tod" signifying upper and "Met" lower.

At the highest point visited the Indus was still a considerable stream. At Giachuruff the ford was always a difficult one, and for eight days after the fall of snow the Pundit experienced the river was not fordable in any way. Whilst it was snowing on the Chomorang range, heavy rain fell at Giachuruff and the river consequently rose very much. The stream was generally very clear and full of fish* of all sizes, up to about 18 inches in length.

The 3rd Pundit, though a very tall powerful man, had great difficulty in crossing when the river was falling; he crossed over to catch their baggage animals which were out grazing, but being delayed till dark, he was unable to venture back, and was consequently kept out all night with hardly a scrap of clothing, he and his companions huddling together in order to keep themselves warm.

From Jiachan to Giachuruff the Indus flows through a rather broad flat valley, and from Giachuruff to its junction with the Garjung-Chu it flows through a similar valley, the banks being lined in many places with long patches of low jungle.

The Indus above the junction was from 100 to 200 paces in breadth with a depth of 6 to 4 feet; while the Garjung-Chu was in places as much as 250 paces in width, but with a depth of only 1 to 2 feet.

The Garjung-Chu between Gartok and the junction flows through a particularly broad and flat valley.

The Indus below the junction flows through a wide valley to a considerable distance below Demchok.

When at Thok-Jalung the Pundit made diligent enquiry as to the adjacent countries, he was informed that a large district called Majin extended for nine days journey to the east, and that a smaller district called Shellifuk lay to the south-east. The Majin country was said to be a difficult one to travel in as no rivers ran through it. The Shellifuk district boasted of some streams, but they all run into a large inland lake.

Immediately to the north of the gold fields there is no regularly inhabited country, as far as the Thok-Jalung people are aware. They say there are some wandering thieves, Champas or Khampas, who live entirely on meat, and have had so little acquaintance with grain in any shape, that they get sick when they take it from their more southerly brethren. The Pundit, however, seemed to have very little faith in this part of the story. He heard that at a considerable distance to the

* The Dokpa people eat these fish, but those Tibetans who have read Budhist books do not do so.

UPPER BASINS
of the
INDUS AND SUTLEJ RIVERS
with the Sources of the
BRAHMAPUTRA AND KURNALI RIVERS.
from
ROUTE SURVEYS MADE BY THE PUNDIT EXPLORERS
Compiled from the original Materials
CAPTAIN T.G. MONTGOMERIE R.E. F.R.G.S.
C. T. SURVEY OF INDIA
References
HANLE
18270
CHUPRANG
17250
GARTOK
15750
CARGUNSA
15190
RAKSTANG
15220
Gurla or
KAILAS PARBAT
Gurla Mandhata 22000
RAWUR CHU-GNA
SAWT HOLE GOLD DISTRICT
MANASAROWAR
LAKE
RIVER INDUS
BRAHMAPUTRA RIVER
HIMALAYA MTS.
TIBET
ASIA
REDUCED FROM THE ORIGINAL BY PHOTOZINCOGRAPHY AT THE OFFICE OF THE SUPERINTENDENT GREAT TRIGONOMETRICAL SURVEY OF INDIA IN DEHRA DOON DECEMBER 1868
Compilation by Captain T.G. Montgomerie R.E. and Hill Shading by Mr. J. Peyton

north-east there was a tract called the Whor country, inhabited by Shakpo people, the same style of people as those who come from Jilung.* Tartary is said to be to the north-east of Whor. To the north-west of Thok-Jalung lies Rudok, the route to which has been roughly indicated on the accompanying map. Ting-Chu and Rawung are the intermediate districts; the first is a very cold place, and has very little sweet water, though plenty of brackish water. Rawung has much the same climate as Rudok, only slightly colder; it has however plenty of fresh water.

There is said to be a direct route from Thok-Jalung, south-east to Tadam monastery on the great Gartok and Lhasa road. This route crosses some comparatively low ranges, but is said generally to run over great plains.

Such inhabitants as there may be on the north, east, and south, are all nomadic, living in standing camps, shifting every now and then according to the state of the pasture, time of the year, &c. They are almost all addicted to highway robbery.

I have already pointed out how well the Pundits have succeeded in the difficult art of intersecting and fixing distant peaks. The way in which the Chief Pundit quartered his ground and divided it, so as to account for the geography of the whole, with a few routes, is another great improvement, their work covering a much greater breadth, and leaving very little doubt as to the position of the intermediate ranges.

As before, the Chief Pundit showed great tact in making his way among strangers, and his conduct of the whole expedition is highly creditable, and the way in which he has carried out my instructions is deserving of all praise.

The 2nd Pundit proved useful in various ways. The 3rd Pundit in his route-survey from Lujan-Chumik to Demchok, and thence to Totling proved that he was thoroughly up to his work, and likely to prove a very valuable addition to the party.

It is a matter of regret that the Pundits were not able to fix the heights of the peaks they intersected, more especially of Aling-Gangri, but as they have now succeeded so well in fixing the positions, it only remains for them to learn to take altitudes to them, in order to determine their heights.

They have already been trained to do this, and I have no doubt but that their next expedition will prove faithful in this respect.

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* Jilung, about one month, north of Lhasa.

Route-Survey—Badrinath to Totling.

Name and Number of Station.	Bearings of forward station.	Distances in paces to forward station.	Remarks.
	° ′		
Badrinath	9 45	3,400	Latitude observations taken at Badrinath near Temple.
2	338 0	1,200	
3	313 0	700	
4	3 30	3,300	
5	351 30	6,100	
6	330 0	4,000	
7	344 0	10,000	
8	315 30	12,700	
9	24 30	11,700	Cross Himalayas by Chirbittia-la.
10	22 45	11,800	
11	67 0	11,700	
12	358 0	4,700	Observations for latitude taken at Lumarti 2,760 paces from station, 12 on route to station 13.
13	28 0	6,000	
14	6 30	6,800	Observations for latitude taken at station 14 (Chirkong).
15	25 0	12,400	
16	27 0	12,000	
17	37 0	5,500	Observations for latitude taken at station 17 (Barku).
18	76 45	10,000	
Totling 19	...	...	Observations for latitude taken at Totling.

Route-Survey—Totling to Thok-Jalung.

Totling	52 0	38,200	Observation for latitude taken at Nairding-Sumdo 12,300 paces from Totling on route to station 20.
20	68 0	50,600	Observations for latitude taken at Khangiah camp 32,300 paces from station 20. Observations for latitude taken at Gugti camp 50,340 paces from station 20.

Route-Survey—Totling to Thok-Jalung,—continued.

Name and Number of Station.	Bearings of forward station.	Distances in paces to forward station.	Remarks.
	° ′		
21	47 0	13,700	
22	85 0	5,300	Observations for latitude taken at Dumlung-Sumdo station 22.
23	62 0	4,500	
24	44 30	11,300	
25	88 15	4,100	Observations for latitude taken at Chojo-Gugti 2,000 paces, and with a bearing of 250° from station 25.
26	98 30	8,000	
27	68 0	9,300	
28	20 45	13,300	
29	48 0	56,000	Observations for latitude taken at Giamchicho 15,300 paces from station 29 on route to station 30.
30	20 0	3,700	Observations for latitude taken at Kiangmachumik 35,500 paces from Giamchicho on route to station 30.
31	44 30	30,600	
32	70 0	19,900	Observations for latitude taken at Giachuruff 5,000 paces from station 31 on station 32.
33	94 0	6,000	Observations for latitude taken at Thok-Jalung 4,000 paces from station 33 on route to end of bazar.
End of Thok-Jalung Bazar	...	...	.....

Route-Survey—Giachuruff to Gartok by Lujan-Chumik and Gar-Gunsa.

	° ′		
Giachuruff	316 30	22,700	
2	300 0	19,100	Latitude observations taken at Shildung camp station 2.
3	290 0	4,100	
4	246 0	5,700	Latitude observations taken at Giamchungphu 2,000 paces from station 4 on route to station 5.
5	291 0	9,400	
6	323 0	4,400	

Route-Survey—Giachuruff to Gartok by Lujan-Chumik and Gar-Gunsa,—continued.

Name and Number of Station.	Bearings of forward station.	Distances in paces to forward station.	Remarks.
	° ′		
7	289 0	17,100	Latitude observations taken at Thankar village 8,000 paces from station 7 on route to station 8.
8	272 0	9,800	
9	225 0	3,500	
10	276 0	6,300	Latitude observations taken at Pika village, station 10.
11	308 0	2,300	
12	242 30	2,000	
13	290 0	3,300	
14	258 0	3,000	
15	265 30	16,500	Latitude observations taken at Burkung 900 paces from station 15 on route to station 16.
16	258 0	11,100	
17	287 0	10,000	Latitude observations taken at Marku camp, station 17.
18	209 0	6,700	
19	255 0	7,800	
20	226 15	5,900	Latitude observations taken at Dak-Maru, or station 20.
21	260 30	29,000	Latitude observations taken at Ralajung 19,900 paces from station 21 on route to station 22.
22	227 45	9,500	
23	143 0	19,500	Latitude observations taken at Lujan-Chumik, or station 23.
24	130 0	24,800	Latitude observations taken at Ju camp, or station 24.
25	150 0	47,200	Latitude observations taken at Gar-Gunsa, or station 25.
26	129 0	26,700	Latitude observations taken at Loa-Gong camp 30,400 paces from Gar-Gunsa on route to station 26.
Gartok	...	...	Latitude observations taken at Gartok.

Route-Survey—Lujan Chumik to Demchok.

Name and Number of Station.	Bearings of forward station.	Distances in paces to forward station.	Remarks.
	° ′		
Lujan-Chumik ...	319 15	16,700	
2	314 30	6,300	Latitude observations taken at Tashikang, or station 2.
3	309 30	18,400	
4	326 42	3,500	Latitude observations taken at Damakolok, same as station 4.
5	311 0	6,700	
6	312 30	1,700	
Demchok	...	...	Latitude observations taken at Demchok.

Route-Survey—Demchok to Totling.

	° ′		
Demchok	312 30	1,000	
7	224 30	3,900	
8	194 30	8,800	Latitude observations taken at Demchok-Phu 5,390 paces from station 8 on route to station 9.
9	186 30	6,900	
10	169 30	2,100	
11	178 0	5,500	
12	158 30	21,900	Latitude observations taken at Dobocho 4,000 paces from station 12 on route to station 13.
13	150 30	12,300	
14	197 30	5,300	Latitude observations taken at Medokding village station 14.
15	117 0	7,200	
16	160 30	8,800	Latitude observations taken at Dilchachini-Sumdo 3,500 paces from station 16 on route to station 17.
17	150 30	20,500	
18	153 0	7,500	Latitude observations taken at bank of Lamocho stream 6,200 paces from station 18 on route to station 19.

Route-Survey—Demchok to Totling,—continued.

Name and Number of Station.	Bearings of forward station.	Distances in paces to forward station.	Remarks.
	° ′		
19	167 30	2,500	
20	134 0	2,600	Latitude observations taken at Jia-Sumdo, or station 20.
21	206 0	12,300	
22	223 0	4,100	Latitude observations taken at Chokche village, 800 paces from station 23 on route to station 24.
23 (same as station 1 below)	317 0	2,700	
24	308 0	5,600	Latitude observations taken at Rabgialing 5,600 paces from station 24.
1 (same as station 23 above) ...	143 0	1,800	
2	139 0	1,500	
3	141 30	16,200	Latitude observations taken at Shangche village, 7,600 paces from station 3 on route to station 4.
4	142 0	3,600	
5	160 0	4,100	
6	114 30	4,000	
7	131 0	10,200	Latitude observations taken at Tibupha 4,900 paces from station 7 on route to station 8.
8	102 0	4,000	
9	69 30	1,700	
10	104 0	4,100	
11	187 30	4,800	Latitude observations taken at Dunkhar village 600 paces from station 11 on route to station 12.
12	181 0	24,300	
Totling	...	...	Latitude observations taken at Totling.

Route-Survey—Barku to Shipki.

	° ′		
Barku	229 0	10,400	
2	224 30	9,500	

Route-Survey—Barku to Shipki,—continued.

Name and Number of Station.	Bearings of forward station.	Distances in paces to forward station.	Remarks.
	° ′		
3	244 0	9,500	
4	237 0	2,000	
5	305 0	1,700	
6	290 30	1,700	
7	234 0	2,700	
8	284 30	2,000	
9	340 0	3,300	Latitude observations taken at Puling-Gongma, or station 9.
10	294 30	3,000	
11	289 0	7,900	
12	292 0	2,500	
13	325 0	4,500	
14	305 0	2,900	
15	323 0	1,900	
16	323 0	13,200	
17	345 0	3,300	
18	322 0	4,500	Latitude observations taken at Rildighang, or station 18.
19	325 0	2,200	
20	301 0	3,300	
21	298 0	9,500	
22	308 0	7,200	Latitude observations taken at Ri village, or station 22.
23	355 0	19,300	Latitude observations taken at Lanjan-Samba (bridge over Sutlej) 8,500 paces from station 23 on route to station 24.
24	324 30	4,600	
25	278 30	8,800	Latitude observations taken at Dongkhang 3,100 paces from station 25 on route to station 26.
26	282 0	11,500	Latitude observations taken at Miang village 2,400 paces from station 26 on route to station 27.
27	216 0	4,000	

Route-Survey—Barku to Shipki,—continued.

Name and Number of Station.	Bearings of forward station.	Distances in paces to forward station.	Remarks.
	° ′		
28	302 0	2,900	Latitude observations taken at Tiak village 500 paces from station 28 on route to station 29.
29	315 0	3,300	
30	264 0	13,900	Latitude observations taken at Kuak village 8,550 paces from station 30 on route to Shipki.
Shipki	...	...	Latitude observations taken at Shipki.

Route-Survey—Shipki to Nilung and Mukpa.

	° ′		
Shipki	84 0	13,900	
2	135 0	3,300	
3	122 0	2,900	
4	302 0	500	
5	167 30	6,600	Latitude observations taken at Tiak village, or station 5.
6	172 30	4,500	Latitude observations taken at Kuang 2,800 paces from station 6 on route to station 7.
7	222 30	3,800	
8	205 0	1,600	
9	170 30	12,300	Latitude observations taken at Sang 4,000 paces from station 9 on route to station 10.
10	160 0	2,000	
11	90 0	8,600	Latitude observations taken at Sumna 5,000 paces from station 11 on route to station 12.
12	133 0	3,200	
13	106 0	3,200	
14	86 0	2,200	
15	53 30	1,300	
16	101 30	6,200	Latitude observations taken at Biar 4,700 paces from station 16 on route to station 17.
17	157 30	2,700	
18	126 30	4,500	

Route-Survey—Shipki to Nilung and Mukpa,—continued.

Name and Number of Station.	Bearings of forward station.	Distances in paces to forward station.	Remarks.
	° ′		
19	129 0	2,800	Latitude observations taken at Sarang village 800 paces from station 19 on route to station 20.
20	152 45	3,700	
21	139 0	1,700	
22	127 30	2,000	
23	130 0	2,300	
24	141 0	1,300	
25	205 0	2,300	
26	156 0	10,000	
27	177 0	6,900	
28	167 0	10,700	
29	202 30	1,900	
30	193 30	3,000	
31	235 0	1,900	
32	188 0	1,900	Latitude observations taken at Changjum-Sumdo 1,280 paces from station 32 on route to station 33.
33	231 0	1,100	
34	176 0	1,100	
35	208 0	2,200	
36	196 0	1,200	
37	153 0	4,300	
38	212 30	1,800	
39	160 0	1,200	
40	192 0	4,400	Latitude observations taken at Nonam 1,600 paces from station 40 on route to station 41.
41	196 30	3,800	
42	158 0	1,400	
43	211 0	2,800	
44	251 30	2,700	

Route-Survey—Shipki to Nilung and Mukpa,—continued.

Name and Number of Station.	Bearings of forward station.	Distances in paces to forward station.	Remarks.
	° ′		
45	263 30	4,300	
46	217 0	1,100	
47	255 30	5,600	Latitude observations taken at Nilung village, or station 47.
48	182 0	2,500	
49	213 0	5,700	
50	220 0	3,700	
51	259 0	5,300	
52	225 0	2,000	
53	257 0	2,000	
54	288 0	5,700	
55	266 0	4,900	
56	259 0	3,200	
Mukpa ...	....	...	Latitude observations taken at Mukpa.

Route-Survey—Gartok to Dunkhar.

	° ′		
Gartok ...	281 0	9,900	Latitude observations taken at Gartok.
2	259 0	7,500	
3	213 30	5,800	
4	259 0	8,000	
5	327 0	5,200	
6	292 30	5,200	
7	315 0	8,000	
8	285 0	4,400	
9	315 0	3,200	
10	270 0	2,800	
11	309 0	10,500	
12	230 0	3,500	
13	306 30	3,100	

Route-Survey—Gartok to Dunkhar,—continued.

Name and Number of Station.	Bearings of forward station.	Distances in paces to forward station.	Remarks.
	° ′		
14	270 0	13,500	
15	146 0	17,300	
16	169 0	16,000	
17	95 0	4,000	
Dunkhar ..	...	...	Latitude observations taken at Dunkhar.

Route-Survey—Dunkhar to Totling.

	° ′		
Dunkhar ...	185 1	5,200	
19	179 0	23,700	
Totling ...	...	...	Latitude observations taken at Totling.

Route-Survey—Totling to Chirkong.

	° ′		
Totling ...	123 30	9,100	
2	200 0	17,300	
3	252 30	6,000	Latitude observations taken at Mangnang village, or station 3.
4	225 0	9,000	
5	242 0	7,700	
6	230 0	7,500	
Chirkong ...			Latitude observations taken at Chirkong.

Route-Survey—Giachuruff to Jiachan up the river Indus.

	° ′		
Giachuruff ...	155 0	7,900	Latitude observations taken at Giachuruff.
2	90 0	2,600	
3	170 0	5,200	
4	208 0	2,400	
5	198 0	5,600	
6	135 0	9,600	

Route-Survey — Giachuruff to Jiachan up the river Indus.

Name and Number of Station.	Bearings of forward station.	Distances in paces to forward station.	Remarks.
	° ′		
7	124 0	10,200	Latitude observations taken at Lapta-Rebo, station 7.
8	193 0	10,000	Latitude observations taken at Nagpo-Shamdo 7,000 paces from station 8 on route to station 9.
9	245 0	8,900	
10	216 0	11,600	
11	190 0	18,900	
Jiachan ...	...	...	Latitude observations taken at Jiachan.

Route-Survey—Milam to Gartok.

	° ′	
Milam ...	33 0	6,400
2	5 0	9,000
3	22 30	2,800
4	333 10	8,200
5	30 0	5,000
6	26 20	6,100
7	52 0	21,500
8	48 40	3,600
9	90 0	1,400
10	71 40	2,900
11	38 30	2,500
12	52 30	12,500
13	46 0	15,400
14	26 0	15,400
15	350 20	11,800
16	358 10	7,600
17	26 0	6,700
18	28 20	2,100

Route-Survey—Milam to Gartok,—continued.

Name and Number of Station.	Bearings of forward station.	Distances in paces to forward station.	Remarks.
	° ′		
19	72 20	6,000	
20	32 20	6,800	
21	318 20	22,600	
22	322 10	10,500	
23	315 40	10,800	
24	335 0	22,900	
25	319 0	20,200	
Gartok ...	...	...	Latitude observations taken at Gartok.

Route-Survey—Gartok to Milam.

	° ′		
Gartok ...	170 20	10,300	Latitude observations taken at Gartok.
27	141 20	8,800	
28	155 30	4,200	Namochi, same as station 29.
29	155 30	10,500	
30	196 10	12,100	
31	235 0	2,200	
32	235 20	21,300	
33	231 30	6,000	
34	171 0	3,500	
35	202 0	2,500	
36	203 10	3,500	
37	191 40	10,500	
38	170 50	3,600	
39	200 0	11,000	Dongpu village, same as station 40.
40	196 0	3,000	Nagbo village, same as station 41.
41	197 30	7,300	
42	194 30	9,700	
43	177 30	13,800	

Route-Survey—Gartok to Milam,—concluded.

Name and Number of Station.	Bearings of forward station.	Distances in paces to forward station.	Remarks.
	° ′		
44	176 0	13,000	
45	176 0	6,700	
46	130 30	16,100	
47	172 0	12,400	
48	166 0	7,900	
5	153 10	8,200	No. 5, 4, 3, 2 correspond with same numbers in route Milam to Gartok.
4	202 30	2,800	
3	185 0	9,000	
2	213 0	6,400	
Milam			

Observations for Latitude taken in Great Tibet with Elliot's 6-inch Radius Sextants, No. 44 and No. 45.

No. of Observations.	Astronomical Date.		Watch Time.	Station.	Object on Meridian.	Upper or Lower Transit.	Double Altitude.	Single.	Index Error.	Deduced Latitudes.	Mean Latitudes.	Remarks.
	1867.		h. m.				° ′ ″			° ′ ″	° ′ ″	
1	May	29	6 30 P.M.	Badrinath Temple (near.)	Polaris.	Lower	58 40 0		+ 8′	30 44 29·4	...	Sextant No. 45.
3	,,	31	6 30 ,,	*Ditto* (foot of steps.)	.....	...	58 41 10		...	30 45 4·7	...	Do.—See observation No. 84.
4	June	7	11 30 ,,	Mana village, Ghonoli house.	Autares.	Upper	66 12 10		+ 3′ 10″	30 45 20·6	30 45 17·8	Ditto.
5	,,	27	10 0 ,,	Ditto.	.....	...	66 12 40		+ 2′ 50″	30 45 15·0		
6	July	27	3 30 ,,	Rában-Thok, Camp Lumarti.	Polaris.	...	65 10 50		+ 2′ 30″	31 11 29·6		Do. took observations for time 6h. 49m. 42s.
7	,,	27	4 30 ,,	Ditto Lumarti.	.....	...	65 18 20		— 7′ 10″	31 10 24·6	31 12 9·7	Do. No. 44.
8	,,	30	3 15 ,,	Ditto ditto.	(*Fomalhaut*)	...	57 4 0		...	31 13 22·3		Ditto.
11	August	1	4 15 ,,	Chirkong or Shibuk.	Polaris.	...	65 23 10		— 7′ 10″	31 12 52·0	31 12 52·0	No. 44.
13	,,	3	4 15 ,,	East of Chaprang village at Thalthousa.	.....	...	65 43 0		+ 2′ 30″	31 27 35·6	31 27 35·6	Do. No. 45.
15	,,	5	4 30 ,,	Totling village.	.....	...	65 43 30		...	31 27 48·9	31 27 48·9	
16	,,	7	11 0 ,,	Nairding-Sumdo Camp.	Altair.	...	134 5 30		— 7′ 10″	31 32 36·7	31 32 36·7	No. 44.
17	,,	10	2 30 A.M.	Khangiah.	(*Fomalhaut*)	...	56 5 0		— 7′ 0″	31 42 52·7	31 42 52·7	Do. near a ravine of the same name.
18	,,	11	5 40 ,,	Dukti Camp.	Polaris.	...	66 25 10		— 7′ 0″	31 44 0·3	31 44 47·0	Sextant No. 44.
19	,,	11	5 40 ,,	Ditto.	.....	...	66 17 0		+ 3′ 0″	31 44 65·8		Do No. 45.
20	,,	11	5 40 ,,	Dukti Camp.	Polaris.	...	66 16 0		+ 5′ 0″	31 45 25·3	...	Pocket Sextant No. 12.
21	,,	12	.....	Fort of Gugti-la.	.....	...	66 23 30		+ 3′ 0″	31 48 18·7	31 47 33·7	Junction of two streams Dunglung-Sumdo.
22	,,	12	.....	Ditto.	.....	...	66 30 30		— 7′ 0″	31 46 48·7		Sextant No. 44.
23	,,	13	.....	Gugti Camp.	.....	...	66 39 20		...	31 51 13·1	31 54 17·5	Chojothal District.
24	,,	13	.....	Ditto.	(*Fomalhaut*)	...	55 25 30		+ 3′ 0″	31 57 21·9		Watch stopped.
26	,,	16	.....	Nabipa-cho.	Polaris.	...	67 0 40		— 7′ 0″	32 1 54·1	32 1 54·1	Ditto.
27	,,	19	4 0 A.M.	Kiangmachumik.	.....	...	67 9 30		+ 3′ 0″	32 11 20·0	32 11 20·0	
28	,,	20	.....	Ginchuruff Camp.	.....	...	67 16 0		...	32 14 34·5	32 14 34·5	District Singmiath, bank of Singi-Chu stream, also called Thok-Somba. Sextant No. 45.
29	,,	26	2 42 A.M.	Thok-Jalung, near gold mine.	.....	...	67 37 0		...	32 25 5·6	32 24 26·5	
30	,,	27	9 30 P.M.	Ditto.	Altair.	...	132 13 0		...	32 13 46·5		
33	,,	30	9 5 ,,	Ditto.	.....	...	132 13 10		...	32 23 41·8		
34	,,	30	12 15 A.M.	Ditto.	(*Fomalhaut*)	...	54 33 30		...	32 23 36·9		
35	,,	30	2 30 ,,	Thok-Jalung.	Polaris.	...	67 37 20		...	32 25 16·8		Sextant No. 45.
36	Sept.	2	12 5 noon.	Singmiath-Puttee.	Sun.	...	132 14 30		...	32 12 38·4	Deduced thermometer 50°.	One and half mile south of Ginchuruff Camp.

Observations for Latitude taken in Great Tibet, &c.,—continued.

No. of Observations.	Astronomical Date.		Watch Time.	Station.	Objects on Meridian.	Upper or Lower Transit.	Double Altitude.	Single.	Index Error.	Deduced Latitudes.	Mean Latitudes.	Remarks.
			h. m.				° ′ ″			° ′ ″	° ′ ″	
37	Sept.	2	11 40 P.M.	Singmaith-Puttee.	Jupiter.	Upper	91 15 10		...	32 11 57·8	Barometer 10·4 in.	One and half mile south of Ginchuruff Camp.
38	,,	,,	.....	Ditto.	Ditto.	...	91 16 0		+5′ 0″	32 10 32·8	32 9 23·6	Pocket Sextant No. 12.
40	,,	3	12 18 A.M.	Ditto.	*(Fomalhaut.)*	...	55 2 0		+3′ 0″	33 9 10·7	...	Wind was high, not confident in the observation.
41	,,	,,	1 0 ,,	Ditto.	Polaris.	...	67 2 0		...	32 7 40·8		
43	,,	4	8 40 P.M.	Shildung Camp.	Altair.	...	132 27 10		...	32 16 42·9	32 19 27·0	Near Mane, not taken on Meridian.
44	,,	,,	2 0 A.M.	Ditto.	Polaris.	...	67 31 10		...	32 22 11·0		
45	,,	5	2 0 ,,	Giamchung-phu Camp.	.....	...	67 40 40		...	32 26 57·5	32 26 57·5	
46	,,	6	8 40 P.M.	Thanker (one house only.)	Altair.	...	132 0 40		...	32 29 57·6	32 30 47·6	
47	,,	,,	2 0 A.M.	Ditto.	Polaris.	...	67 50 0		...	32 31 37·6		
49	,,	7	8 30 P.M.	Pika Village.	Altair.	...	131 58 0		...	32 31 18·2		
50	,,	,,	11 30 ,,	Ditto.	*(Fomalhaut.)*	...	54 18 50		...	32 30 59·0	32 31 43·1	
51	,,	,,	1 30 A.M.	Ditto.	Polaris.	...	67 51 20		...	32 32 17·5		
52	,,	8	8 20 P.M.	Barkung Village (in ruins.)	Altair.	...	131 55 10		...	32 32 43·3		
53	,,	,,	1 36 A.M.	Ditto.	Polaris.	...	67 52 50		...	32 33 2·8	32 32 53·1	
54	,,	9	8 15 P.M.	Marku Camp.	Altair.	...	131 58 30		...	32 31 3·6	32 31 3·6	Near Singi-Chu stream.
55	,,	10	8 18 ,,	Dak-Maru.	Ditto.	...	132 0 30		+2′ 30″	32 30 18·8	32 30 8·0	
56	,,	,,	11 48 ,,	Ditto.	Polaris.	...	67 46 50		...	32 29 47·2		(Near Gamuk Village) on bank of Singi-Chu stream.
57	,,	11	8 15 ,,	Ralajung.	Altair.	...	132 5 0		...	32 28 4·4	32 27 52·6	On bank of Singi-Chu stream.
58	,,	,,	1 30 A.M.	Ditto.	Polaris.	...	67 42 40		...	32 27 40·7		
59	,,	12	8 15 P.M.	Lujan-Chumik Camp.	Altair.	...	132 11 40		...	32 24 44·5	32 24 35·1	
60	,,	,,	1 25 A.M.	Ditto.	Polaris.	...	67 36 10		...	32 24 25·6		
61	,,	13	8 0 P.M.	Name unknown.	Altair.	...	132 30 50		−7′ 0″	32 17 54·6	32 18 22·8	
62	,,	13	1 30 A.M.	Ditto.	Polaris.	...	67 30 30		...	32 18 50·9		
63	,,	14	7 55 P.M.	Gargunsa Village.	Altair.	...	132 50 0		...	32 10 19·0	32 8 45·6	
64	,,	14	1 25 A.M.	Ditto.	Polaris.	...	67 11 10		...	32 7 12·1		
65	,,	15	7 50 P.M.	Loa-Gong Camp.	Altair.	...	133 10 30		...	32 0 3·6	31 57 45·6	
66	,,	15	1 40 A.M.	Ditto.	Polaris.	...	66 47 40		...	31 55 28·1		
67	,,	16	1 30 ,,	Garyarsa, large village.	.....	...	66 22 30		...	31 42 50·6		
68	,,	16	7 30 P.M.	Ditto.	Altair.	...	133 40 30		...	31 45 4·2	31 43 54·0	
69	,,	18	.....	Ditto.	.....	...	133 40 40		...	31 44 59·3		
70	,,	19	1 0 A.M.	Ditto.	Polaris.	...	66 22 10		...	31 42 41·6		
71	,,	24	7 15 P.M.	Dunkhar Village.	Altair.	...	133 47 30		...	31 41 34·1		
73	,,	24	5 0 A.M.	Ditto.	Orionis. *(Rigel.)*	...	100 3 0		...	31 41 7·7	31 41 20·9	
74	,,	25	noon.	Ditto.	Sun.	...	115 54 30		...	31 14 38·9		

76	"	28	7 35 P. M.	Totling monastery.	Altair.	...	134 9 40		...	31 30 30·3				
77	"	28	10 45 "	Ditto.	(*Fomalhaut.*)	...	56 31 0		...	31 29 56·2				
79	"	29	5 51 A. M.	Ditto.	Orionis. (*Rigel.*)	...	100 26 0		...	31 29 39·8		31 30 4·7	Date mistaken.	
80	"	30	noon.	Ditto.	Sun.	...	112 23 10		— 7′ 0″	31 30 22·5				
81	Oct.	2	5 40 A. M.	Ditto.	Orionis. (*Rigel*)	...	100 25 30		...	31 29 54·6				
82	"	4	7 0 P. M.	Mangnang Village.	Altair.	...	134 27 0		...	31 21 50·1				
83	"	"	5 30 A. M.	Ditto.	Orionis. (*Rigel*)	...	100 41 50		...	31 21 44·2		31 21 47·2		
84	Nov.	14	.....	Badrinath Temple.	Do.	...	101 56 50		...	30 44 9·9		... ...	Watch not going. See observations 1 and 3 preceding.	
1	Sept.	13	.....	Tashikang Village.	Altair.	...	132 2 0		+ 3′ 0″	32 29 19·4				
2	"	"	.....	Ditto.	Polaris.	...	67 49 0		...	32 31 6·7		32 30 13·1	Observations taken near monastery. Deduced thermometer 55°, barometer 18·2 inches.	
3	"	14	.....	Domakolok Camp.	Altair.	...	131 46 0		...	32 37 18·6				
4	"	"	.....	Ditto.	Polaris.	...	68 4 40		...	32 38 0·8		32 38 9·7	Ditto.	
5	"	15	.....	Domchok Village.	Altair.	...	131 40 0		...	32 40 18·6				
6	"	"	.....	Ditto.	(*Fomalhaut*)	...	53 58 0		...	32 41 22·0		32 41 38·5	Thermometer 55°, barometer 18·2 inches.	
7	"	15	.....	Ditto.	Polaris.	...	69 11 30		...	32 42 26·2				
8	"	16	.....	Domchok-phu Camp.	Altair.	...	131 45 20		...	32 37 38·1				
9	"	"	.....	Ditto.	Polaris.	...	68 5 20		...	32 39 23·3		32 38 30·7	Deduced thermometer 55°, barometer 17·5 inches.	
10	"	17	.....	Deboche.	(*Fomalhaut*)	...	54 22 30		...	32 20 2·3				
11	"	"	.....	Ditto.	Polaris.	...	67 45 0		...	32 20 15·1		32 29 8·7	Thermometer 51°, barometer 16·8 inches.	
12	"	18	.....	Madok Sing.	Altair.	...	132 22 0		...	32 19 17·5				
13	"	"	.....	Ditto.	Polaris.	...	67 28 50		...	32 21 10·5		32 20 14·0	Ditto.	
14	"	19	.....	Dilchachini-Sumdo.	Altair.	...	132 36 30		...	32 12 3·4		32 13 3·7	Junction of two streams (Sumdo), thermometer 52°, barometer 17·2 inches.	
15	"	"	.....	Ditto.	Polaris.	...	67 14 40		+ 3′ 0″	32 14 4·3		32 13 3·7	Ditto.	
16	"	20	.....	Right bank of Lamoche stream.	Altair.	...	132 58 30		...	32 1 2·9				
17	"	"	.....	Ditto.	(*Fomalhaut*)	...	55 19 30		...	32 0 32·6		32 0 47·8	Thermometer 53°, barometer 17·4 inches.	
18	"	21	.....	Near Jin-Sumdo.	Altair.	...	133 1 10		...	31 59 43·0		31 59 43·0	Ditto.	
19	"	22	.....	Rabgialing (near monastery.)	.....	...	133 10 20		...	31 55 8·0				
20	"	"	.....	Ditto.	(*Fomalhaut*)	...	55 30 30		...	31 55 2·4		31 53 37·0	Thermometer 53°, barometer 17·5 inches.	
21	"	"	.....	Ditto.	Polaris.	...	66 30 50		...	31 52 8·8				
22	"	23	.....	Chokcho Village.	Altair.	...	133 14 40		...	31 52 59·2				
23	"	"	.....	Ditto.	(*Fomalhaut*)	...	55 34 40		...	31 52 59·1		31 52 58·2	Thermometer 54°, barometer 17·8 inches.	
24	"	24	.....	Shangcho Village (near.)	Altair.	...	133 21 40		...	31 49 28·3				
25	"	"	.....	Ditto.	(*Fomalhaut*)	...	55 42 30		...	31 49 3·6		31 49 16·0	Thermometer 54°, barometer 18·0 inches.	
26	"	25	.....	Tibu-phu.	Altair.	...	133 36 0		...	31 42 18·4				
27	"	"	.....	Ditto.	(*Fomalhaut*)	...	55 58 0		...	31 41 18·7		31 42 0·7	Thermometer 55°, barometer 18·2 inches.	
28	"	"	.....	Ditto.	Polaris.	...	66 11 0		...	31 42 12·8				
29	"	26	.....	Dunkhar Village.	Altair.	...	133 43 20		...	31 39 9·1				
30	"	"	.....	Ditto.	(*Fomalhaut*)	...	56 0 10		...	31 40 16·8		31 39 34·1	600 paces south-west of village.	
31	"	"	.....	Ditto.	Polaris.	...	66 5 30		...	31 39 25·2				

Observations for Latitude taken in Great Tibet, &c.,—continued.

No. of Observations.	Astronomical Date.		Watch Time.	Station.	Object on Meridian.	Upper or Lower Transit.	Double Altitude.	Single.	Index Error.	Deduced Latitudes.	Mean Latitudes.	Remarks.
			h. m.				° ′ ″			° ′ ″	° ′ ″	
1	Sep.	30	7 25 P.M.	Barku Village.	Altair.	Upper	134 10 0		+ 2′ 0″	31 25 50·4		
2	,,	,,	10 30 ,,	Ditto.	(*Fomalhaut*)	...	56 30 0		...	31 25 55·9	31 25 52·0	
3	,,	,,	5 0 A.M.	Ditto.	Orionis. (*Rigel*)	...	100 24 40		...	31 25 49·7		
4	Oct.	2	7 30 P.M.	Puling-gongma.	Altair.	...	134 20 50		...	31 20 24·7		
5	,,	,,	10 16 ,,	Ditto.	(*Fomalhaut*)	...	56 41 0		...	31 20 22·7	31 20 20·2	Camp.
6	,,	,,	4 30 A.M.	Ditto.	Orionis. (*Rigel*)	...	100 35 50		...	31 20 13·3		
7	,,	4	7 30 P.M.	Rildighang Village.	Altair.	...	134 0 0		...	31 30 50·3		
8	,,	,,	10 10 ,,	Ditto.	(*Fomalhaut*)	...	56 17 0		...	31 32 25·0		
10	,,	,,	4 40 A.M.	Ditto.	Orionis. (*Rigel*)	...	100 13 40		...	31 31 19·5	31 31 9·9	
11	,,	,,	5 40 ,,	Ditto.	(*Sirius*)	...	83 55 0		...	31 30 4·7		
12	,,	5	7 30 P.M.	Ri Village.	Altair.	...	133 48 10		...	31 36 45·1		
13	,,	,,	10 55 ,,	Ditto.	(*Fomalhaut*)	...	56 8 20		...	31 36 43·9		
14	,,	,,	4 56 A.M.	Ditto.	α Orionis.	...	131 30 0		...	31 37 0·7	31 36 58·5	
15	,,	,,	5 42 ,,	Ditto.	(*Sirius*)	...	83 42 0		...	31 36 34·1		
17	,,	6	12 15 ,,	Ditto.	Polaris.	...	66 2 0		...	31 37 11·0		
18	,,	7	7 20 P.M.	Lanjan Samba.	Altair.	...	133 39 30		...	31 41 7·0		
19	,,	,,	5 33 A.M.	Ditto.	*Sirius*	...	83 33 0		...	31 41 9·0	31 41 8·0	Near bridge over Sutlej river.
20	,,	8	9 42 P.M.	Dongkhang.	(*Fomalhaut*)	...	55 51 0		+ 2′ 0″	31 45 24·6		
21	,,	,,	5 30 A.M.	Ditto.	(*Sirius*)	...	83 22 40		...	31 46 14·7	31 45 49·7	
22	,,	9	12 o'clock.	Miang Village.	Polaris.	...	66 23 0		...	31 47 38·0		
23	,,	,,	3 53 A.M.	Ditto.	Orionis. (*Rigel*)	...	99 42 0		...	31 47 11·5	13 47 10·3	(Midnight.)
24	,,	,,	5 21 ,,	Ditto.	(*Sirius*)	...	83 22 0		...	31 46 37·7		
25	,,	10	9 30 P.M.	Tiak Village.	(*Fomalhaut*)	...	55 48 10		...	31 46 58·8		
26	,,	,,	5 15 A.M.	Ditto.	(*Sirius*)	...	83 21 20		...	31 47 0·2	31 46 59·5	
27	,,	11	6 20 P.M.	Shipki Village.	Altair.	...	133 24 50		...	31 48 27·5		
28	,,	,,	9 23 ,,	Ditto.	(*Fomalhaut*)	...	55 44 50		...	31 48 37·4		
29	,,	,,	3 40 A.M.	Ditto.	Orionis. (*Rigel*)	...	99 39 40		...	31 48 22·8	31 48 25·6	
30	,,	,,	5 10 ,,	Ditto.	(*Sirius*)	...	83 18 50		...	31 48 14·5		
31	,,	12	6 12 P.M.	Kuak Village.	Altair.	...	133 27 20		...	31 47 12·3		
32	,,	,,	11 48 ,,	Ditto.	Polaris.	...	66 24 40		...	31 48 26·8	31 47 49·6	
33	,,	14	9 6 ,,	Kuang Village	(*Fomalhaut*)	...	55 53 50		...	31 44 0·5		
34	,,	,,	3 22 A.M.	Ditto.	Orionis. (*Rigel*)	...	99 48 50		...	31 43 44·7	31 43 52·6	

37	"	16	8 55 P.M.	Sumna Village.	(*Fomalhaut*)	...	56 8 20	...	31 36 43·2	31 36 43·2		
38	"	17	8 50 P. M.	Beghar or Baikar Village.	(*Fomalhaut*)	...	56 6 50	+ 2′ 0″	31 37 32·1	31 37 32·1		
39	"	18	8 45 "	Sarang Village.	.....	...	56 13 40	...	31 34 5·3			
40	"	"	10 55 "	Ditto.	Polaris.	...	65 56 0	...	31 34 12·6			
41	"	"	3 4 A. M.	*Ditto.*	{ Orionis. } { (*Rigel*) }	...	100 8 30	...	31 33 54·6	31 34 10·3		
42	"	"	3 32 "	Ditto.	(*Sirius*)	...	83 46 50	...	31 34 10·3			
43	"	20	11 30 "	Ditto.	Sun.	...	96 58 40	...	31 34 29·8			On meridian.
44	"	23	8 20 P. M.	Changjum Sumdo.	(*Fomalhaut*)	...	56 47 10	...	31 17 18·6	31 17 18·6		
45	"	24	8 15 "	Nonam.	.....	...	57 0 40	...	31 10 33·4	31 10 33·4		
46	"	25	8 10 "	Chongsa or Nilung Village.	.....	...	57 7 30	...	31 7 10·3			
47	"	26	noon.	Ditto.	Sun.	...	93 41 40	...	31 6 16·5			
48	"	"	8 5 P. M.	Ditto.	(*Fomalhaut*)	...	57 9 50	...	31 6 0·2			
49	"	29	7 50 "	Ditto.	.....	...	57 10 0	...	31 5 54·8			
50	"	"	.....	Ditto.	{ Orionis. } { (*Rigel*) }	...	101 4 30	...	31 5 54·0	31 6 17·9		Watch ceased going.
51	"	"	.....	Ditto.	(*Sirius*)	...	84 43 0	...	31 6 4·5			Ditto.
52	"	"	.....	Ditto.	*Procyon.*	...	128 55 50	...	31 5 4·6			Ditto.
53	"	30	noon.	Ditto.	Sun.	...	90 56 40	...	31 7 58·2			
55	Nov.	6	.....	Mukpa Village.	.....		86 42 20	...	31 2 25·6			
56	"	"	7 55 P. M.	Ditto.	(*Fomalhaut*)		57 18 30	...	31 1 44·3			
57	"	7	noon.	Ditto.	Sun.		86 5 40	...	31 2 47·2	31 2 10·8		
58	"	8	7 55 P. M.	Ditto.	(*Fomalhaut*)		57 18 20	...	31 1 49·1			
59	"	"	.....	Ditto.	(*Sirius*)		84 51 20	...	31 1 56·4			
61	"	9	noon.	Ditto.	Sun.		84 56 20	+ 2′ 0″	31 2 21·9	31 2 10·8		
1	August.	28	.....	Lapta-rebo Camp.	Polaris.		66 58 10	— 7′ 0″	32 0 23·0	32 0 23·0		
2	,	29	.....	Jiachin Camp.	(*Fomalhaut*)	Upper	55 20 30	...	32 5 27·3	32 5 27·3		A little after transit.
3	"	30	.....	Nagpo Shamdo Camp.	Polaris.		66 44 0	...	31 53 19·2	31 53 19·2		

Observations of the Boiling Point taken in Great Tibet.

No. of Station.	Astronomical Date.		Watch Time.	Station.	Thermometer.		Thermometer.		Deduced height above Sea.	Remarks.
					No.	Boiling Point.	No.	In Air.		
	1867.		h. m.							
1	June	28	5 42 P. M.	Badrinath	22	195·40	30	60° 0	10,234	On first step of temple.
2	July	4	8 30 A. M.	Mana Village, 1¼ mile N. of Badrinath ...	,,	195·10	,,	64° 0	10,510	
3	,,	5	4 30 P. M.	Do.	,,	195·00	,,	66° 0		
4	,,	26	7 0 A. M.	Ghastoli (halting place)	,,	190·40	38	51° 0	13,251	
5	,,	26	7 0 ,,	Ditto	30	191·00	,,	50° 0		
6	,,	27	3 0 P. M.	Tare (foot of hill)	,,	185·50	,,	50° 0	16,587	
7	,,	28	9 0 A. M.	Hutoli (pile of stones)	,,	182· 0	,,	37° 0	18,576	On crest of pass, also called Chirbitiala and Doongri-la.
8	,,	30	noon.	Lumarti-Sumdo Camp	,,	185·50	,,	57° 5	16,660	
9	,,	30	.....	Ditto	22	185·40	,,	57° 5	16,817	
10	August.	1	5 47 A. M.	Ditto	30	185·50	,,	30° 0	16,396	
11	,,	2	7 40 ,,	Chirkong	,,	187· 0	,,	53° 5	15,708	
12	,,	4	6 8 ,,	Barku Village	,,	191·50	,,	55° 5	13,005	
13	,,	5	4 0 P. M.	Totling monastery	,,	192·75	,,	69° 0	12,295	On house top about 15 feet above ground and 60 feet above river.
14	,,	7	7 0 ,,	Be-Songbo-ka-Sumdo	,,	191·50	,,	64° 0	13,050	Junction of streams.
15	,,	8	6 8 ,,	(Larcha) Bogola (foot of mountain) ...	,,	187·50	,,	49° 0	15,364	
16	,,	9	9 0 A. M.	Bogola	,,	181·00	,,	40° 0	19,220	On crest of pass.
17	,,	9	6 30 P. M.	On other side of Bogola	,,	186·50	,,	45° 5	15,935	Foot of mountain.
18	,,	10	6 30 ,,	Khangiah Camp	,,	188·00	,,	58·25	15,129	
19	,,	11	5 10 ,,	Gugti Camp	,,	188·00	,,	67·50	15,205	On bank of Gugti stream.
20	,,	12	4 25 ,,	Gugti-Sumdo	,,	184·50	,,	62·50	17,324	Junction of streams.
21	,,	13	9 0 A. M.	Gugti-la	,,	180·50	,,	37·00	19,490	On crest of pass.
22	,,	13	5 45 P. M.	(Chojothol) Gugti Camp	,,	185· 0	,,	58·25	16,968	On the other side of Gugti-la.
23	,,	14	5 5 ,,	Lojang Camp	,,	188· 0	,,	58·25	16,353	On bank of Lang-Chu stream.
24	,,	15	6 0 ,,	Chojo-Gunsa	,,	187· 0	,,	53·00	15,700	Ditto.
25	,,	16	6 36 ,,	Name not known	,,	187·75	,,	58·25	15,289	
26	,,	19	4 23 ,,	Kiangma Chumik	,,	185·50	,,	59·00	16,669	Halting place where water is procurable.
27	,,	20	9 0 A. M.	Paba-la	,,	183·75	,,	49·25	17,619	On crest of pass.
28	,,	20	5 30 P. M.	(In Puttie Singmiath) Glachuruff ...	,,	187·00	,,	57·00	15,732	Camp on bank of Singi-Chu stream.
29	,,	22	3 53 ,,	Chomorang-la	,,	185·00	30	56·00	16,949	Foot of mountain.
30	,,	23	6 0 ,,	Chomorang Camp	,,	184·50	,,	45·00	17,151	
31	,,	27	7 0 A. M.	Thok-Jalung (near gold mine)	,,	185·75	,,	41·00	16,346	16,337.
32	,,	29	2 50 P. M.	Ditto	,,	186·00	,,	55·00	16,327	
33	,,	31	3 0 ,,	Chomorang-la	,,	182·00	,,	53·00	18,765	On top of mountain.

34	Sept.	4	6 15	„	Shildung Camp	...	„	188·75	3	53·00	14,652	Near stream.
35	„	5	4 23	„	Gianchung (Gopha) ...	...	„	188·50	„	62·50	14,861	
36	„	6	5 30	„	Thanker Village ...	...	„	188·75	„	59·75	14,688	On bank of Singi-Chu, about 12 feet over the water.
37	„	7	5 52	„	Pika Village ...	...	„	188·80	„	56·75	14,637	
38	„	8	6 30	A.M.	Ditto ...	...	„	189·00	„	40· 0	14,398	
39	„	„	3 36	P.M.	Burkung Village, (in ruins)	...	„	189·40	„	64· 0	14,324	On bank of Singi-Chu stream.
40	„	9	4 15	„	Marku Camp ...	...	„	189·75	„	57· 5	14,071	Ditto.
41	„	10	5 12	„	Dak Maru (red hill) ...	...	„	190·60	„	58·25	13,920	On top of hill.
42	„	11	6 2	A.M.	Ditto ...	...	„	190·50	„	23·00	13,393	
43	„	„	5 35	P.M.	Ralajung (on bank of Singi-chu)		„	191·50	„	68·50	13,022	
44	„	12	5 55	„	Lujan-Chumik ...	...	„	191·50	„	54·50	12,999	On bank of Garjung-Chu stream.
45	„	13	5 0	„	On bank of Garjung-chu stream		„	191·00	„	53·00	13,287	
46	„	14	5 30	„	Gurgunsa Village, near stream ...		„	189·50	„	47·00	14,147	
47	„	15	5 30	„	Loagong (Rebo) Camp ...		38	188·75	„	49·00	14,391	
48	„	17	5 30	A.M.	Garyarsa (monastery)...		„	188·75	„	30·00	14,211	
49	„	25	9 0	„	Dunkhar Village ...		„	190·00	„	51·50	13,652	
50	„	30	6 55	„	Totling (monastery) ...		„	192·50	„	42·00	12,101	
51	October.	5	8 0	„	Mangnang Village ...		22	190·80	„	supposed 30	12,867	
1	August.	25	5 30	P.M.	Gobarteja-rebo ...		38	187·00	„	56·00	15,295	In Puttie Singmiath.
2	„	28	6 30	A.M.	Chakrang Camp ...		„	186·50	„	40·00	15,459	
3	„	29	7 0	„	Niarcher Camp ...		„	186·50	„	44·30	15,709	
4	„	„	5 30	P.M.	Jiachan Gûnsa, (house)		„	186·25	„	47·25	15,878	
5	Sept.	23	6 30	A.M.	Tashikong Village ...		30	191·50	„	60·25	13,027	Near monastery.
1	October.	1	6 30	„	Barku Village ...		38	191·75	„	34· 0	12,503	
2	„	2	6 12	„	Sharbarak-chu ...		„	190·00	„	36·25	13,515	
3	„	3	6 6	„	Puling-Gongma Camp		„	189·50	„	29·50	13,801	
4	„	5	5 50	„	Rildizhang Camp ...		„	189·50	„	17·00	13,709	
5	„	6	5 15	„	Ri Village ...		„	189·75	„	26·50	13,634	
6	„	8	5 59	„	Lanjam-Samba, (near)		„	196·00	„	39·75	10,039	On bank of Sutlej River.
7	„	„	4 38	P.M.	Sirang-la		„	185·00	„	32·00	16,491	On top of mountain.
8	„	9	6 0	A.M.	Dongkhang (one house)		„	189·50	„	.....	.....	The mercury sunk so low that the thermometer could not be read.
9	„	10	5 51	„	Mian Village ...		„	193·50	„	30· 0	11,458	
10	„	11	6 37	P.M.	Tiak Village ...		„	196·75	„	36·50	9,592	
11	„	12	6 25	A.M.	Shipki Village ...		„	196·00	„	35·00	10,027	On top of a house.
12	„	13	5 28	„	Kuak Village ...		„	196·00	„	37·50	10,030	
13	„	15	7 32	„	Kuang Village ...		„	191·50	„	27·00	12,610	
14	„	„	12 24	P.M.	Pungrang-che-la ...		„	185·75	„	34·00	16,057	On crest of pass.
15	„	16	7 7	A.M.	Sang Village ...		„	189·50	„	18·00	13,715	
16	„	„	12 42	P.M.	Pimik-che-la ...		„	183·50	„	33·00	17,403	Ditto.
17	„	17	7 35	A.M.	Sûmna (junction of streams)		„	190·50	„	28·00	13,201	
18	„	18	7 6	„	Bikar Village ...		„	194·00	„	38·00	11,201	
19	„	19	8 55	„	Saráng Village ...		„	193·00	„	37·50	11,783	
20	„	22	12 55	P.M.	Tago-la		„	184·50	„	34·00	16,810	On crest of pass.
21	„	24	7 32	A.M.	Samdo Changjum Camp		„	190·75	„	16·00	12,934	
22	„	25	7 22	„	Nonam Village ...		„	191·50	„	22·00	12,583	
23	„	27	6 30	P.M.	Nilung or Chorsa Village		„	194·00	„	32·00	11,181	
24	„	30	1 8	„	Ditto ...		„	193·75	„	51·00	11,407	
25	Nov.	7	4 46	„	Mukpa Village ...		„	199·25	„	48·00	8,172	Alongside Dhurumsala.
26	„	11	6 42	A.M.	Ditto ...		„	199·50	„	34·00	8,012	

II.—TOPOGRAPHICAL SURVEY.

MEMORANDA ON THE FORT OF BANDOGURH, BY LIEUTENANT R. V. RIDDELL, R. E., IN CHARGE NO. 5, TOPOGRAPHICAL PARTY, REWAH AND BUNDELCUND SURVEY.

The fort called Bandogurh is situated in north latitude 23° 41′, east longitude 81° 5′ in the south portion of Rewah, and is very nearly in the centre of a pergunnah named after itself.

2. The fort may be roughly described as an immense rock, nearly rectangular in shape, measuring at the top about 2,000 yards from east to west by 1,300 yards from north to south and rising to a height of about 1,000 feet above the valleys, at its base inaccessible from the south side, and very nearly so from the three others.

At the few places where the sides of the rock do not form a natural wall, walls have been built, and there guns are in position and guards always stationed.

3. The ascent to the fort lies in a gorge from the village of Gopalpore situated at the foot of the rock, on the east end of the north face. At about five-sixth of the height from the foot of the hill, a curtain wall or parapet of masonry stretches right across this gorge, and on this guns are mounted. I noticed three or four at one part and several piles of shot glistening in the sun; the commandant of the fort informed me that ten guns were mounted on this wall and there certainly is room for any number.

Farther up the gully I noticed a masonry edifice which looked like a large gateway forming another obstacle to the ascent on the western slope of the gully.

4. There used to be an entrance to the fort on the east side, but it has been closed and not been in use for many years. In the wall at the top of the slope there are from 11 to 13 embrasures; these are at different elevations, extending along the side of the hill which led me to suppose that the ground behind the wall has not been reduced to a uniform level.

5. The road (a mere bridle path) chiefly used by the Rewah officials, and the inhabitants of the neighbouring villages on the north side for communication with the fort is that from "Tála" (a village of about 500 inhabitants, at which there is a thannah) on the left bank of the Cherrangunga, distant about four miles from the fort.

From Tála the road lies through about half a mile of open country, and then enters a gorge between the hills "Durwar" and "Chittarhai" through which the Cherranganga, a beautifully clear mountain stream, finds its exit. The next half mile of this gorge possesses every means of being made impassable, as the sides of the hills on both sides rise precipitously, and the narrow level space between them is covered with a mass of very large trees. About a quarter of a mile beyond this gorge, the road from Tála is joined by another from a small village called "Bijeria," which crosses a neck of the Chittarhai hill, passable for cattle, mules or elephants.

At the junction of these two roads a guard was stationed to oppose my progress, and I was obliged to forego the pleasure of obtaining by

minute personal inspection, information concerning the near approach to this place so mysteriously kept, but from more distant observation I did not think that this road presented any obstacles between this point and Gopalpore, which is used more as an out-post to the fort than for any other purpose.

6. Another entrance through the outer belt of hills is from the village of Mahâwan on the west side of the fort, this path passes between the hills "Bandani" and "Durwar", and is, I should think, the easiest entrance to Gopalpore; guns bear on this entrance from the north-west corner of the rock. I did not notice any such precaution observed with regard to the other entrances, though guns could easily be brought to bear on any of them from more than one part of the fort.

7. From the east there are two roads from the villages of "Gagour" and "Lakumar," respectively, the former follows for a time the left bank of the "Belwin" Nuddy at the foot of the south side of the hills called "Boggara" and "Maihiarchouk," and then winds round the north side of a hill south-west of "Maihiarchuk" into Gopalpore. That from Lakumar passes north of the Boggara hill, and crosses the "Baruha" nuddy below the east end of the Chittarhai hill, and thence winds into Gopalpore; both roads are easy bridle paths.

8. From the south there is a road from the village of Gohari, which, after crossing some swampy ground, partly cultivated with rice, within a mile of the fort or rock, passes between the fort and the hill called Bandeni; this road seems considerably used. That from Mahawah is very little used, and lies through dense forest on ground so slightly undulating as to be nearly level, until it reaches the gorge north of Bandeni. There is another road from the villages of "Ghata" and "Marhoun" which passes over the ridge joining the Bando rock with the trigonometrical station of Rampore, but this is not passable for cattle, and is very little used.

9. A further examination was impossible as I could not pass the guards which were stationed at every entrance to the valley on the north side of the fort, but as I visited all the hills having any view in the neighbourhood, except Bandeni, which was not only prohibited to me by an arrangement between the Political authorities and the Rewah Chief, but was, as far as I could see, not attainable, except to a monkey or a sailor. I think I accomplished all that was possible.

10. The slopes of all these hills are very steep and in many places perfectly precipitous. The hill called Boggara and the two between it and the fort are almost bare of forest; on the top of the former a patch of trees grow, but the slopes, until near the foot, are too precipitous, on all but the eastern spur, up which lies the best ascent. There are trees at the top of Bandeni, but a great deal of bare ground on the southern spur. I failed to discover where an ascent could be made to this hill, some of my guides said that men could ascend, but none would tell me by what route, and most of them declared they had never heard of a man having made the ascent. With the exception of those above specified, all these hills are covered with forest, but the undergrowth is small.

11. The highest point of the whole group of hills is near the south scarp of the fort, where a dot marks the spot on the plan, the

height being 2,662 feet. The surface of the rock slopes down towards the north, which edge is, I should think, from 100 to 150 feet lower than the southern. The top of Bandeni is 2,629 feet above the sea, only 33 feet lower than the highest part of Bandogurh, and considerably higher than the greater portion of the surface of the rock.

The "Durwar" hill is 2,115 feet in elevation, or about 550 feet lower than the fort. The shortest distance between the two hills is about 1,500 yards.

The "Chitarhai" hill is about 250 feet lower than the Durwar, and is about the same distance from the fort as Durwar; "Baggara" is nearly 3,000 yards from the nearest point of the fort, and its height is 2,233 feet; "Maihian Chouk" is about the same height as Durwar, but the top is a mere pinnacle about 40 yards in width at the most, with perpendicular sides for about 30 feet from the top.

The hill on which the trigonometrical station of Rampore is built is 2,375 feet in height, and is about 2,400 yards distant from the eastern side of the fort. The highest parts of the ridge joining this with the fort are about 500 feet lower than the highest part of the fort, the ascent to this from the south side is perfectly practicable for mules or elephants lightly laden, but the descent on the north side is much more precipitous.

12. The Cherrangunga springs from the north side of the rock on the west side of Gopalpore, and is said to flow at all seasons. The "Baruha" was dry when I was in the neighbourhood in the month of January. The "Behi," rising from the north side of the Rampore hill, is said never to run dry.

The "Damnar" or "Douna" running eastwards along the south foot of the hills also has water in it at all seasons.

The supply of water in the fort is chiefly procurable from tanks, some said there were as many as twelve of these, but the most straightforward of my informers said that there are only four which can always be depended upon, and that a large amount of the water used by the garrison is brought up from the Cherragunga.

13. Report says that large quantities of grain and provisions are stored in the fort. The accounts as to the strength of the garrison were the most variable, some said 300 sepoys, some 1,500; the space covered by huts and in the fort is about equivalent to a village of 1,200 inhabitants, I should think that there might be 500 fighting men in the place.

I heard that, for the past three or four years repairs have been in course of execution all round the walls, and also that from about the same date a steady supply of ammunition has been sent into the fort.

14. So jealous are these people of any information connected with the fort becoming known to Europeans, that they were in the habit of changing my guides daily, and invariably sent me as stupid men as possible, while I was working in the neighbourhood of the fort.

A year before Lieutenant Badgley failed to obtain mortar to repair the Great Trigonometrical station of Rampore as they thought he wanted to build a post of observation or something equally absurd.

15. The plan of Bandogurh on the scale of 2 inches=1 mile, has been enlarged from my original plane table section, and though not more accurate or trustworthy than the work from which it was prepared, will, as a mere military sketch, on account of its larger size, and the proportionally smaller space occupied by the printing, be perhaps found more useful.

16. I have just heard from the Political Assistant of Nagode, that the plan of the fort, prepared by the Rewah Chief, has been sent to me, but it has not yet arrived. If it should come before this is dispatched, and there should be anything in it worth embodying in my plan, it shall be done.

MEMORANDUM AS TO GEOLOGY OF JAINTIA HILLS AND AS TO THE DISTRIBUTION OF TRIBES.

Geological formation of Jaintia hills.

16. The western boundary of the district of the Jaintia hills is the river Mangat, crossed on the direct road from the Lailangkote to Jawai; the valley is deep and extremely picturesque, the hills rising from the narrow strip of rice land at the bottom, in steep slopes of grass and wooded ravines, close under the crest, into precipitous cliffs. Nongjirong hill is very conspicuous. The formation here is metamorphic, a well stratified gneiss, and in the bed of the river the boulders are almost entirely of that rock with quartzitic sandstone, and a few of dark green trap. Ascending from the river to the top of the slopes of the left bank, and passing the village of Simanting on the right, a short distance, the first patches of a stratified rock are seen; this is a coarse gritty sandstone of light color, forming the tops of the little eminences, and never exceeding here perhaps twenty feet in thickness. They are lost sight of as soon as the descent into the Mantadu commences, where the metamorphic rocks at a high angle are seen again; the sandstone series re-appearing when the opposite ascent is crowned. A strong interbedded conglomerate is very noticeable here, and always lying at the base of this formation. Its chief peculiarity now consists in the beds of dark purple hue, in others of so fine a white that they might almost be mistaken for chalk,—broken up and mixed with water, is used largely as a whitewash for the sides of the native huts in the place. These sandstones (of considerable thickness) now form the mass of all the elevated points in Jawai, and are conspicuous near the dâk bungalow, resting horizontally on the highly tilted older rocks. On the hill mass of Chermang, south of Jawai and the Mantadu, its thickness has greatly increased, bringing in above the conglomerates, thinner and finer beds less sandy in composition, and here we find traces of the carboniferous shales, and in places a dark, hard, earthy coal, often wanting, invariably thin bedded, and altogether very local in its distribution. To the east of Latuber, the same features may be seen all the way to Satunga, the metamorphics appearing on the higher parts of the plateaus, where the sandstone occurs in isolated thin patches. But at Satunga with a fall in the hills, we are introduced to a new series altogether, *viz.*, the limestone (nummulitic), of which an outlier forms a mass with low

perpendicular and jagged sides to the right of road, and on the very edge of the southern depression of the level of the country. To the south-west one or two wooded isolated knolls show the limits of the northern extension. It rests on the sandstones in this locality (also with their associated coal beds), and there is no doubt that these last are of secondary age, prototypes of rocks better developed under Cherrapoonjee, fining out at Maobelarkar, on the road to Shillong. There is also an appearance of unconformability of succession between these secondary strata and the nummulitic pointing to a long lapse of time and very different conditions of surface before the deposition of the limestone began. Here we are also near the confines of the tertiary sea, in which they were formed as shown by the thinning out of the limestone beds. Proceeding south to the low range of hills of which War H. S. forms the highest point, the limestone has greatly increased in thickness, and is superimposed at the same time by beds of quite a different mineralogical character, being nodular, ferruginous, and highly fossiliferous; above this well marked horizon no limestone with nummulites were seen, local unconformability of these last is noticeable, due either to a falling in of the limestone, but what I am more inclined to think a prior denudation of surface; the fossils are minute with an occasional gastropod of larger size. This ridge, on the north of which lies Nongkhli, well known as one of the last strongholds of the Jaintias during the rebellion of 1861-62, is succeeded on the south by the main-ridge and watershed of the hills, the stream at Nongkhli being a feeder of the Kopili. Crossing a low pass at the head of the last-mentioned stream, the view that suddenly opens out is almost Himalayan: below lies the deep valley of the Umsnat, backed on the east by the high mass of Marangksi; its precipitous cliffs showing out grandly against the noble forest that covers all else. In this great section, everything above the nummulitic is exposed, this last forming the bottom beds in the valley, succeeded by the fossiliferous ferruginous strata, and again above by an enormous thickness of soft, thick-bedded sandstones of light ochre-tint, and this higher mass is the universal rock of all the higher forest-clad hills running thence due east to Asalu. In the bed of the Umsnat the limestone is almost horizontal, but lower down has a very slight dip southward. It also thickens in this direction very rapidly with interstratified beds of sandstone. The whole mass preserves its horizontality, and there is nothing very noticeable over a large and broad band, save that with the deepening valley, lower beds of the limestone are exposed; but in no spot did I see sandstone of cretaceous age, or that which could be mistaken for it. The Umsnat joins the Semling, and the united streams form the Lubah, which forms a junction with the Barak near Molagul. The Semling and Lubah form a deep valley with an east and west strike, and the mass of the upper nummulitic or tertiary sandstone rises precipitously on the south, forming a ridge parallel with it: upon this line the first bending over to the south commences; the best section to observe this is near Katom, where the Lubah turns south in a gorge cutting diagonally right across the whole mountain mass; the solid limestone of great thickness and the higher sandstones all dip over together, becoming perpendicular, and are succeeded at this

point by a thin bedded series of newer rocks, clays, and sandstones of various colors and hardness; the angles of dip varying slightly north and south of the perpendicular show a great crushing, *perhaps* a folding, of the beds. As we leave the higher hills for the low eminences (Tilas), the sandstones are coarser, and have springs of small pebbles scattered through them, also large lumps of lignite. In one place the whole of the roots and part of the trunk of a large tree were seen in the perpendicular strata of the river bank. These last-mentioned rocks are evidently of lower Sewalik age, and are capped unconformably further into the plains by masses of irregularly bedded clays and conglomerate which pass under the present alluvial surface.

Before closing my remarks on the geology of the Jaintia hills, the nummulitic coal should be alluded to. This has long been known to exist at Lakadong, and was there, I believe, once worked; the same formation occurs at many points further east, particularly near Narpo, at no great distance from the Luba river, navigable for small boats: its value has yet to be made known and perhaps established: there is no reason why beds of considerable extent should not, with proper search, be discovered. Its position high in the nummulitic limestone is precisely the same as that at Cherrapoonjee. This coal is nowhere met with east of the Lubah and Umsnat rivers.

Physical configuration of Jaintia hills in connection with geology.

17. The most striking feature of part of the Khasia range of hills is the extremely even height of the central mass; nowhere is this so well seen as from the peaks of the North Cachar range. Marangksi, &c., the dead level line of the whole mass as far east as Tiniang H. S., is from here most noticeable, even the distant Shillong peaks make hardly any show in the distance. This central mass or high table-land is all of gneiss, generally at a high angle, and the denudation it has been subjected to must have been enormous prior to the secondary epoch. It falls very gradually to the south for a long distance, with a last sudden dip over Jaintiapur. On the north the lower levels are successively reached by a series of steps that can be followed for many miles. The last descent being the greatest, corresponding to the like sudden depression at Nunklow, &c., Tiniang and Saranthu mark the limits of this table-land on the east, and overlook the much lower country of the valley of the Kopili. In the Jaintia district the trap rock comes in with the northern fall in the country, and the high isolated peaks to the south of the Mangkhen are found to be a continuation of the quartzitic sandstones of the Shillong peak, &c., almost perpendicular, but lying up against an amygdaloid trap associated with a true granite, which comes in with an east and west run on the north, and forms the remarkable rounded bosses, such as Billu, Kongor, &c. Granite also occurs contiguous to the gneiss north of Nartiang and thence in an easterly direction immediately north of Nongjinghi, which is almost the highest point of the Jaintia hills, 4,563 feet above the sea level. The Nongjinghi ridge is gneiss resting against the granite. As at Lailangkote in the Khasia hills, the trap is closely associated with the granite, and in such situations, the titaniferous iron sand is found in great quantity, and smelting furnaces are seen in all the adjacent

villages. This dark green dyallagic trap appears to have been injected between the granite and gneiss, or quartzitic sandstones, at or about the period of the great disturbance and change in the metamorphic series. The parallelism of the drainage lines south-east of Jawai is very remarkable, and with the cross drainage at right angles, breaks the country up into irregular parrallelograms, which probably display a monster jointing of these metamorphic rocks: the most remarkable lines taken up in succession by different great valleys and ravines are—

1st, a main line rather irregular, but to which all lines to the south conform; commencing from the west at Karpenter village on the Mangat, that river carries it to Jarain E. N. E. and up to the junction of the Kawa-Manvi with the Mantadu, north-westerly by the Keremontha ravine past Wapang into the Umpaai, and by the Mureen into the Kopili near Khangasi, this last river continuing for many miles with a north-easterly course altogether constituting a great physical feature extending from west to east for fifty-five miles.

The 2nd line at an average distance of six miles to south of the first can be traced from Pomtadong, past Thangbuli to the Mantadu river, at junction of the Raliang on the left bank, following this last named river over the watershed into the Lonnang river and in succession by the Umkorpong to the north of Satunga, where this river turns sharp at right angles to the south, yet the same direction can be carried on to Umthnong, and is lost in the sudden W. S. W. bend of the Kopili.

The 3rd line can be taken up at the base of the hills near Jaintiapur by the river Rangpani into the Umchaliang S. W. N. E., crossing the Mantadu again to the Lamu river past Thampianai Great Trigonometrical Survey into the Pamesken by a succession of ravines to the N. W. of Khleriat, where the last stream, the Shashem, turns to the S. S. E.

The same run, but with a more east and west course, is taken up in succession on the north by the Muntang and Manriang rivers, tributaries of the Kopili, and lastly by the Mangkhen.

These great lines of continuous depression are again displayed on the south and east, and show there a decided curvature. I may note the Lubah, Simleng and Arten into the head waters of the Kopili north of Sherfaisip, and again further south the deep depression marked by the valleys of the Koomra, Larangkayeng into the Jatinga, and taken up on the north of the main watershed at Asalu by the valley of the Dhansiri. To the southward of this trough, the strata are found tilted high in that direction, giving the more pointed shape to the peaks of the south-west Borail range. The line is intimately connected with the original elevation of the whole mountain mass, and the parallel continuous lines already noticed are doubtless due to the same parallel forces of elevation. As might be expected the geological formations all coincide with these great natural flexures, carrying the nummulitic series with its limestone and cretaceous rocks far north on the Kopili and thus into the valley of Assam.

Distribution of different races and tribes.

18. On the east of the Jaintia hills, the Sintengs are succeeded by races differing from them much in language and customs. The principal of these are the Mikirs, Kùkies, and Cacha-

ries. On the north some petty sub-tribes are met with, differing, more or less, from the Sintengs or hill people of the table land; these are known at Lalùs and Bhois; the former are a small community inhabiting the area of the last slopes between the rivers Mantriang and Umiam. Their burial rites appear peculiar, and differ from any people I have met with. They do not intermarry with either of their neighbours, the Bhois and Mikirs.

The Bhois are the people of the jungles in contradistinction to those of the high open lands, yet even when they move up into this latter portion of the country, they still retain their individuality and name of Bhoi.

Colonies of Mikirs are found in Kharwang, Jingthong, and on the Umiam, in Nongflùt, on the north-east, and down again in the south-east corner of the Jaintia District on the Simling; some of these last have even crossed the Kalangtam ridge into the Koomrah valley; they are a good looking, fair race, quiet, civil, and industrious; the women are excellent weavers, and a large proportion of the strong, close woven, red and white striped *chudders* are made by these people and fetch high prices.

On the south-east, and extending along the high line of hills, Kùki tribes replace the Mikir; there are many sub-divisions of these, but the Purana (Rankhor and Kùchùng) appear the most numerous. The Bateh, a sub-division of the Purana Kùkies, are few in number, only two or three villages. These last bury their dead in a spot adjacent to the village, setting up boughs, with inverted gourds, skulls of animals, &c., stuck on them. The head-dress of the women is also peculiar. The Changsels are another Kùki tribe, emigrants from the south-eastern hills bounding Tipperah; they are found in the hills east of the Jatinga. The Purana Kùkies have apparently adopted Hindoo notions and customs, and burn their dead, make offerings to Hindoo deities, &c. With all these last mentioned tribes, the love of song and the dance is universal, and establishes an individuality and a marked difference between them and the Khasia and Sinteng.

The Cachari is only found in the low lands close to and along the very base of the hills; they are divided into (1) Birmons, (2) Dhaos. Some of them have again emigrated, following the Kopili river, and some are, I believe, to be seen near Gowhatty.

III.—REVENUE SURVEY.

DESCRIPTION OF COUNTRY SURVEYED IN DISTRICT BURAICH, SEASON 1867-68, BY CAPT. A. D. VANRENEN, REVENUE SURVEYOR, 2ND DIVISION, OUDE.

1. TRACT OF COUNTRY SURVEYED—DESCRIPTION, &c.—The tract surveyed contains the larger part of the Nanpara Tehseel, or these pergunnahs contained in it—Bhinga, Churda, and Dhurmanpore; that portion of the country lying along the right bank of the Raptee and along the Buhkla nullah is well cultivated, and the soil seems very rich; in the spring of the year, it looks like one large green field of waving grain in

ear, here and there open, where the village sites are located, and about them are to be seen large groves of trees for which this part of India is so famed. To the north and along the Nepal boundary line we come to part of the ill-famed Terai, with its deadly climate in certain seasons of the year, and which, now that timber has become so valuable, is carefully conserved, and has been made over to the officers of the Forest Department. To the north-west this belt of forest covers nearly the whole of the Dhurmanpore pergunnah, and only about the chief town itself do we meet with any open ground, which is rather low and seems to have been caused by the receding of the Kourialla river. This open ground is one sheet of cultivation, and has a most picturesque appearance, being green throughout the year, with a background of dense forest growing on the heights. The lower Himalayan ranges are distinctly visible, and on clear days the distant snowy range, with its rugged and lofty peaks, can be seen, making a beautiful view. The villages have mostly a desolate appearance; they are nearly all built of mud, with very few pucca houses, and in many places, are mere clearances in the jungle.

2. River Kourialla.—The river Kourialla here forms the boundary between Kheree and Buraich; it is navigable throughout. When there is a demand for grain in the country lower down, numerous boats are freighted and sent up to the towns of Kheree and Buraich along its banks; a great deal of timber is likewise rafted down to Buhram Ghaut, now one of the largest sâl timber marts in the country. The navigation ceases at the Golah Ghaut, a short distance from the boundary line. Where it leaves the hills, there is a beautiful fall called "Sheesh-Panee" in the Nepal territory, which is visited by pilgrims and visitors. Like other great rivers flowing through low alluvial tracts, it is divided into many streams, communicating in the rainy season by numerous off-sets with the parent stream and with each other.

3. Girwa River.—The Girwa river is one of its tributaries here; it is a prettily wooded stream; its bed is covered with large boulders near where it enters British territory, the Futtehghur Gun Carriage Agency station; during the cold weather months an Overseer selects sissoo timber, suitable to the requirements of the manufactory, which is then floated down the Girwa and Kourialla in rafts, and sent across country to Futtehghur, where it is stored for many years, and thoroughly seasoned before being made into gun carriages. Near this, there is a ford during the cold weather admitting of the passage of camels and baggage animals; but as the water is very cold, the current very [redacted] and the bed very rough, care must be taken that they have only [redacted] loads, and have men near at hand to help them up in case they stum[redacted] about a quarter of a mile lower down, there is a ferry where there [redacted] always several boats plying to and fro.

4. River Sarjoo.—The river Sarjoo here is a large stream in the rains, and overflows its banks; it is likewise constantly shifting its bed: as this stream and the Girwa pass through valuable timber forests belonging to us and Nepal, they are largely used to float down timber into the Kourialla, which they both join soon after debouching into the plains. Mr. Bourne thus describes the other smaller streams, *viz.*, the Bhada,

Chooka, and Bubuyee: "They present a very unusual appearance to the eye in the dry weather, looking in fact like long strips of *jheels*; trees of considerable size, tiger-grass and reeds grow in their beds throughout their entire length and breadth. The inhabitants do not drink the water of any of them on account of its deleterious effects on the system; possibly owing to the presence of decayed vegetable matter in the water, and further say, that no person can continue to drink long of the water and live." Every village has a number of wells from which the drinking water is obtained. Near the forests they are often square shaped frames of timber being used to keep their sides from falling in, and some of these appear to have lasted a number of years.

5. ROADS.—The only road of importance is the one from the Kourialla river to Nepalgunj through Nanpara, which is embanked and bridged in places, and on which there is a great traffic during the dry months, the exports from Nepal being sâl timber, spices, and its valuable iron; and the imports being cotton and woollen cloths. The other roads are mere village paths; on those leading from large villages, carts can be used during the dry months; when the local funds admit of it. I believe, a new road is to be made from Nanpara to Mookeepoor, where there is a police station, and which is the last one at this end of the district.

6. CROPS, &c.—The usual crops common to this part of the country are raised, and except when the rains fail, the harvests are so good as to have obtained for Oude the name of the "Garden of India," although this applies more to the other districts, Buraich being for Oude a poor one. The dews are very heavy, and which must afford considerable nourishment to the crops. Excepting in the small vegetable gardens about the villages, irrigation is seldom applied to the fields in Buraich.

7. THE WANDERING TRIBE OF BRINJARAHS.—In the Dhurmanpore pergunnah there are several villages of Brinjarahs who have good grazing for their large herds of pack bullocks in the jungles so near at hand, and nearly all the salt trade along the edges of the Terai is carried on by them.

8. JUNGLE CROPS MUCH INJURED BY WILD ANIMALS.—So much of the country being covered with jungle, it affords great shelter to all the deer tribe and wild pig, who do great mischief to the crops, and although the fields on the jungle side are protected by high thorny hedges, and are likewise carefully watched day and night by the cultivators themselves, perched on some platform in a tree, or raised on an eminence, yet these animals often break through the hedges, and destroy in a few hours the produce of months of toil. Mr. Bourne states: "That he has seen a field of wh[illegible]t, of an area of thirty to forty acres, so overrun and destroyed by these animals, that the owner had to turn in his own cattle to graze upon what remained, evidently considering that it was no longer worth his while to hope for a harvest." The general disarmament of the country must likewise have tended to the increase of wild animals, as now the possession of a gun and the purchase of gunpowder entail many formularies, and many would sooner dispense with their guns than undergo them.

9. FORESTS.—So many of our most valuable forests having been made over to Nepal after the mutiny, and as the demand for the valuable kinds of timber is daily increasing, the forests which we still possess are carefully attended to by the officials of the Forest Department, and all over

them are located small posts of *chupprassees*, who see that the rules laid down by Government are carried out, and that the young trees are not injured by the villagers. During the cold weather months, or as soon as the forests can be visited without risk of getting fever, they are inspected by the European officers of the department. I have heard timber merchants and others, more than once remark, that our being able to send to market a few valuable logs now and then, has a most salutary effect on the Nepalese Government, who otherwise would have the entire monopoly of the trade, as they now own, beyond comparison, the finest forests and where alone sâl timber of the largest scantling can be procured.

10. BURAICH FORESTS: EIGHT KINDS OF TREES ORDERED FOR CONSERVATION.—The forests of Buraich having been the nearest available, all the large trees, I am told, were cut down before annexation; and in passing through them, I noticed that all the trees seemed to be of young growth, and the forests would not be productive for many years to come. At the time of survey the following six kinds of forest trees were ordered for conservation :—

1. Sâl—Shorea Robusta.
2. Sisso—Dalbergia.
3. Toon—Cedrela Toona.
4. Ebony—Diospyras Melanoxylon.
5. Dhao—Conocarpus Latifolia.
6. Assana—Terminalia Tomentosa.

In August last these two trees were added to the list, *viz.*:—

7. Khair—Acacia Catechu.
8. Tikooee or Huldoo—Naaclea Cordifolia.

11. RESTRICTIONS PLACED ON VILLAGERS ABOUT CUTTING TIMBER SEVERELY FELT BY THEM.—The restrictions placed on the villagers near the forests, who for years previous had been allowed to roam the woods at large, cutting down almost what timber they required, and grazing their cattle, have caused much grumbling and dissatisfaction, and some new rules, I am informed, are to be shortly issued, allotting them a certain area of forest for fuel (the eight reserved woods not to be cut,) and grazing purposes in proportion to the size of the village, which I have no doubt will make them quite contented.

12. AN ABORIGINAL TRIBE "THE THAROOS."—On the edges of many of these forests, and on the Nepal boundary, we met with an aboriginal tribe called "Tharoos," and they put me in mind of the Gonds, Sherrias, &c., inhabiting the jungle surveyed by me in Central India. They are in many respects very like their Central India brethren, in physical appearance almost alike, but they are much more industrious, as the fields they cultivated, with their numerous water-cuts for irrigation show, and altogether more settled and less savage. They keep almost exclusively to the Terai and forest, living where no one else can live. The new forest rules have been severely felt by these shy and timid people; and as by the transfer of the Oude Terai, the great mass of them have now become subjects of the Nepal Government, a great many of our Tharoo villagers, dissatisfied with the restrictions placed on them about cutting wood in, and roaming about, the forests, have left our territory and joined their brethren in Nepal, and if I am rightly informed, a welcome is given them by the Nepalese officials. The people from the plains give them a bad name, and say that they are afraid to enter the Tharoo

villages in small parties for fear of being bewitched, as these wild men believe in *bhoots* and familiar spirits. Mr. Thomas Patterson thus writes of them, after surveying a number of their villages: "The Tharoos left the country in a mass for Nepal, after the annexation: all that now remains of the industry of these people are the numerous canals cut for irrigation purposes; these intersect the country in all direction; they are now dry, and are not used by the few who remain. A whole village of these Tharoos came out to see the survey operations; they were quite anxious to do something for us, if only to assist in pulling the chain: they owned large herds of buffaloes, which obtained good pasturage in the adjoining deserted villages. They were a wild-looking lot of fellows, plain-spoken, and of independent bearing; the natives who affected to treat them with comtempt said they were of no particular caste, would eat anything from a dead rat upwards; large herds of antelope abound here, and mix quite freely with the cattle." He likewise describes the devastation caused by the deer and wild animals to growing crops, and states "that they have to be watched all night, and that small sheds are erected in the fields at intervals of two hundred feet apart, two upright pieces of wood are let in the ground, from which a large stone is suspended, and by means of strings attached to them, and pulled by men in the sheds, they act like clappers, making a noise and frightening away the animals from the young grain in the fields."

13. FORESTS ABOUND WITH GAME.—These forests abound with all the large species of game: tigers, leopards, the deer kind, wild pig, &c., and are the scene of those enormous haunks, or battues, we see described in the histories of the Kings of Oude; even now they are still visited by European parties after *shikar*, and by the large and wealthy talookdars, such as the Rajahs of Kupoorthulla and Bulrampore, who come about the beginning of the hot weather, as water becomes scarce, with numerous elephants, and have generally good sport; and whilst we were in the field, we heard of many tigers having fallen; although they are still numerous, yet they seldom attack men, and for some years past no report has been received by our officials of their having injured any one; this immunity is doubtless attributable to their being so well supplied with food from the herds of deer and other large animals, which are in such numbers in the forests, it is said, that the tiger has a preference for the flesh of the wild pig; some well authenticated anecdotes are likwise told of the fearless way in which the cattle-keepers, with only a stick in their hands, go up to them and frighten them off when they have pounced upon any of their herds.

14. RUINS OF MUD FORTS STILL VISIBLE: LAWLESS STATE THE COUNTRY WAS IN IN FORMER YEARS.—The ruins of numerous mud forts are still to be seen, which reminds one of the lawless state in which this country was before and about the time of annexation of the province; when numerous bands of robbers and dacoits, under such noted leaders as Fuzul Allee and others, who, having good hiding places in the Terai, would issue from it into the open country, and rob and murder the people; and at one time Fuzul Allee actually threatened Buraich, compelliug the Europeans there to take refuge in the jail, which was the only place admitting of defence.

15. CHOLERA OF 1867.—Whilst visiting the Dhurmanpore pergunnah many sad tales were told me of the fearful mortality caused by that dire disease cholera in the spring of the preceding year 1867, which had more than decimated the villages on the edge of the Terai. The disease first broke out in Maharajah Jung Bahadoor's large camp, after he had entered the lower hills, and whilst marching to the plains to attend some marriage ceremony of his family. From this it gradually spread to the Nepal villages on the boundary, and first appeared in our territory at the large village of "Bhurtapore" on the Kourialla river. At the villages of "Lalbojha," and "Boojhia" which are quite near each other, the head-men give a sad and detailed account how the disease was brought to their village from Bhurtapore by a shepherd who, having taken his flock to graze in the better pastures there, had in alarm fled back to his village. A day or two after his arrival the plague showed itself, and to it nearly one-third of the people of the village fell victims. Cholera had not been known in this somewhat-isolated part of the country for ten or twelve years previous. In the forests about here thousands of cattle are sent from the southern parts of the district for the sake of the grass. The keepers in charge of them were likewise attacked by this disease, and so many died from it that a friend, who had been here at this time, told me that the herds were roaming about quite wild and unattended, their owners not being able to procure substitutes to take charge of them, so terror-stricken were the people. As the hot weather came on, the disease spread through the district, and it raged with great violence at Buraich itself. Although there were solitary cases of it in the villages we were surveying, I am thankful to add none of our establishment were attacked, and before it became worse the camp broke up.

16. LOCAL IMPROVEMENTS DISCUSSED.—The only local improvements, I could suggest, would be more roads to open the northern parts of the district, and which will be perhaps made hereafter when the local funds permit it. The people are very backward with irrigation, and the numerous streams which traverse the district in all directions may be made of use hereafter by masonry weirs being built across them to store up the water, and give them thus the means of applying it to their fields; this project has, I believe, been very ably discussed by Mr. J. Anderson, the present Deputy Commissioner, an old Canal Officer; and when the country becomes more peopled hereafter, it may be worth while to carry out such costly projects, which would doubtless be of great benefit. When the settlement is over, schemes of improvement for the development of the country will, I have no doubt, be taken in hand by the people themselves.

17. VILLAGERS READY TO ASSIST.—The villagers were invariably ready to assist us; the Assistant's camp being often-times visited by the head-men. Along the Raptee and in the Chunda pergunnah there are several talookdars who, having, as Government servants in the army, and civil departments, done good service in the mutiny, were rewarded by having villages bestowed on them. Some of them have built fine pucca bungalows and bazaars, and their more advanced ideas will be a good example to the other landholders; amongst those who deserve particular mention is the Nawab Nessar Allee Khan of Allahabad, Honorary

Assistant Commissioner, formerly in the Educational Department, Punjab, and a son of the Kuzulbash Nawab, who aided in the release of the Cabul prisoners, also Heera Sing, a pensioned Ressaldar of Fane's Horse, who did distinguished service in the mutiny and last China Campaign, and who entertains extensive ideas of irrigation and other projects to improve his talooka.

18. DESCRIPTION OF VILLAGES.—Of the villages, I can say but little; few of them are of any note; here and there, where the local talookdar resides, they have some local importance. Near the jungles many of them are constructed of timber and wicker-work—most combustible materials, as the villagers have found to their cost, and which they will give up now that restrictions are placed on cutting timber. The large villages for these parts are Rampoor, Dhobuhahar, Churda Khas, Hurkhapoor and Bhurthapoor. At Motcepoor it is intended to build a new pucca police station-house. At present the police are stationed in mere wicker-work sheds to the north of the town.

LANDOUR; *The 26th October* 1868. } A. D. VANRENEN, *Captain, Revenue Surveyor, 2nd Division, Oude.*

DESCRIPTION OF COUNTRY SURVEYED IN DISTRICT SEONEE, SEASON 1867-68, BY CAPTAIN R. E. OAKES, REVENUE SURVEYOR, 1ST DIVISION, CENTRAL PROVINCES.

POSITION ON MAPS.—The season's work, 1,200 square miles odd, extends over a tract lying between the parallels of 21° 45′ and 22° 24′, and meridians of 79° 26′ and 80° 16′, and comprises portions of Tehseelees Seonee and Kuttenghee of district Seonee. It is bounded on the north by the surveyed portion of Seonee and by the Weingunga river; on the east by the Weingunga which divides Seonee district from Mundla and Balaghat, on the south by Bhundara and by the unsurveyed portion of Kuttenghee, and on the west by the Chindwarra district.

TOPOGRAPHICAL FEATURES.—From the Chindwarra boundary on the north, the Seonee plateau (the highest in the district) extends as far as the forest lands to the south, in a continuous open and highly cultivated plain; the soil light and in places sandy; from Seonee Khas it is broken up by slight hills and jungle tracts interspersed with open patches of cultivation for about eight miles in a south-easterly direction, when there is a descent into a second plateau also highly cultivated extending as far as the forest reserves of Sonaiwanee and the Ooglee pergunnah. Both of these are highly cultivated and produce good crops of wheat, the pulses, and, where irrigation is resorted to, sugarcane; this latter is however small and poor.

FOREST AND JUNGLE.—Bordering the lower plateau is a continuous belt of forest and bamboo jungle which stretches continuously from the north-east along the hilly and sloping edges of the plateau, taking a course to the west from Sonaiwanee and dividing the high lands of the district from the low lands in the Weingunga valley.

VALLEY OF WEINGUNGA.—The Weingunga valley is a vast plain of rice cultivation during the rains, and is justly celebrated for the excellent quality of its rice, which is exported towards Nagpore and the Deccan;

the rice crop is succeeded by *toor*, a pulse which is grown in great quantities as an article of food for the inhabitants.

This valley is plentifully supplied with tanks and streams which appear to hold water throughout the year; the valley to the south of Sonaiwanee opens out into an extensive plain which stretches away towards Phundara and the Nagpore country.

The descent from the high land to the Weingunga valley is gradual and imperceptible to the north-east, and reaches the valley by a cart track through the villages of Doonda Seonee, Burghat, Tuctooa, and Sooa, some miles south of the point where the Weingunga takes an abrupt turn from west and east to north and south.

Road and Tracks.—All roads south of this descend by passes more or less abrupt, but two are easily practicable for the small carts of the district, and can be traversed by bullock coaches, buggies, and other springed conveyances, as they are bridged; one of them, the Seonee and Kuttenghee road, is partially metalled, and at slight cost could be converted into an excellent road: the bridges are principally wooden structures.

The principal roads in the district are the great Deccan road which joins Jubbulpore and Nagpore; it runs through the tract under discussion from the village of Nukghir in a southerly direction through Seonee; it is an excellent road, bridged and metalled throughout, with staging and Road Engineers' bungalows at convenient distances.

Encamping grounds have been marked out at every march, and mangoe topes planted within the last few years. There are also wells dug at each encampment.

The telegraph wire on iron and wooden posts follows the course of the road, only leaving at right and left when the road deviates from a straight line. The road of next importance is the Kuttenghee road which is bridged and partially metalled (wooden bridges). It leads from Seonee Khas to Kuttenghee, where there is a tehseelee and public garden; there are two passes of fairly easy gradient, the one near the village of Dalol descending into the lower plateau, the 2nd where it descends from the high lands into the Kuttenghee plain; both these ghâts require repairs, but a few thousand rupees would put them in very good order. They are rather steep in places, but perfectly practicable for spring two-wheeled conveyances and for laden district carts.

The road from Seonee to Balaghat passes through Burghat to Lalburra; it is practicable for country carts, and descends into Kuttenghee plain by a good pass which is bridged in places with masonry bridges; the road is unmetalled.

All other descents to the plain are only practicable for pack-bullocks and foot passengers. The Seonee and Chindwarra road leaves the Seonee district in the village of Koka; it is an unmade road.

Rivers.—There are several rivers running through the season's work, the principal one, the Weingunga, rises on the Seonee plateau, in the village of Purtapore, flows north to the village of Purtapore, where it turns to the west and again runs north between steep banks as far as Chupara in last season's work, where it is deflected to the east, which course it pursues as far as the village of Portalpanee in the north-eastern end of the present season's survey, where it turns sharply to the south

and skirts the Seonee district, dividing it from Balaghat as far as the Bhundara boundary.

After it debouches into the Kuttenghee plain, the bed is generally sandy with an occasional barrier of rock as in the village of Peepureea in the south-east of the district, where the river rushes through a small opening with a fall of a few feet.

It is not navigable, but timber could doubtless be floated through great part of its course during the rains. It abounds in *mahaseer* and other fish, and like all rivers in these provinces, is infested with *muggers* in the deep khoonds and reaches of still water.

In many places the scenery of the river is very picturesque, especially before it leaves the high lands, where its course is between very high rocky banks. In the village of Portalpanee the bed lies between rugged perpendicular sides of upwards of 150 feet in height.

The Pench river borders the present season's work for only a very short distance on the south-west, where I found its bed sandy and shallow, and about 176 yards across. The Hirree rises near Dhobee Surrie and runs in a north-easterly direction through the district to its junction with the Weingunga in the village of Koorsarra; it flows through very rugged rocky banks in the latter part of its course before it descends into the Kuttenghee valley.

Besides these, several minor streams flow through the district.

Fords.—There are fords on the Weingunga at Kurpuria Chickly, at Khoorsurra, at Gooreyra, impracticable for carts. In west land Gooreyra there is a ford practicable for country carts. There are no ferries for large boats.

Tanks.—The principal tanks are to be found in the villages of Seonee Khas, Aree Mohgaon, Purtapore, Lalburra, Panderwanee, Sookturra; they are generally formed of natural hollows and bunded at one end; most of them are stocked with fish, and are covered with wild fowl in the cold weather.

Towns and Villages.—The principal towns and villages are Seonee Khas, Wara Seonee, the tola of Pandurwanee, locally called Lalburra, Kuttenghee Khas, Jam Nugpoora, Nawurgaon, Hiljee Mohgaon, Bugowlee, Hutnapore, Khumuria, Jellore, Kaleeroth Munjleepett, Astha Ruttianpore, Nukeewara, Agurwara, Oomarla, Dondeewara, Pandurwanee, Surreka Kuttenghirree, Khoorseepar (local name Ooglee) Mohburra Jurekha, Chapara, Seonee Khas; the civil station of the whole district is a town containing a population of 8,026 which is divided as follows:—Hindoos 7,511, Mussulmen 515.

The site of the city and civil stations occupies portions of three villages. The latitude and longitude of Ramchunder Patail's house has been determined by the Great Trigonometrical Survey, latitude 22° 05′= 32″·78, longitude 79° 35′=07·56″. There is a very fine tank with a good carriage drive all round, which adds greatly to the appearance, and probably to the salubrity of the station.

The public buildings are, a good market, Deputy Commissioner's kutcherry, which is also the treasury, the jail, the telegraph office, the police lines and hospital, the dispensary, and dâk bungalow.

There are also public gardens and a very fine swimming bath.

The climate of Seonee is very superior to that of Jubbulpore and Nagpore, and certainly much more healthy. It would no doubt be

often visited as a sanatarium by invalids if there were any houses available, which unfortunately there are not.

The principal buildings in the native town are, the mosques and temples and the house of the Nawab (jagheerdar of portion of the Ooglee talooka), a large brick edifice with enclosed gardens, greatly needing repairs. The principal trades of the town are manufactures of tusser silk and dyeing.

A market is held daily in Boodwaree bazaar, and once a week in Bhyroogunj. Although Seonee is, I believe, comparatively free from fever and malarious diseases, it was visited during the season of 1867-68 by cholera in a severe form; the scourge appears to have been propagated by, if it did not originate with, the numerous gangs of workmen employed on the great Deccan road, and was probably caused by the impurity of the water they drank; except at the halting stages there are but few wells along the road, and the workmen are compelled to use the stagnant water of the nullahs for drinking and washing purposes. In a season of drought, as this has been, the pools become scarce and shallow and the water absolutely poisonous, and a fertile cause of sickness which might, no doubt, be greatly mitigated by having wells sunk every few miles, say at each dâk stage of five miles.

The cost would add but little to the charge of keeping the road, and the benefits would be incalculable and lasting.

The principal grain and cattle market of the district is Wara Seonee, a village in the south-eastern corner of the Kuttenghee tehseelee; a perpetual market is held here, and most of the exports from Seonee are disposed of to traders, whence they are conveyed south by Brinjarras' bullocks and country carts. There are a pucka market place, a thannah, and a dispensary.

Kuttenghee Khas is a small village but rising into importance, it is the head-quarters of the sub-division of that name, and has a tehselee and public garden.

Lalburra is a place of importance, a market is held there twice a week. There is a pucka market place and a police thannah. It is celebrated for its cloth manufacture. There is a thannah and distilleries at Gourjhola, otherwise unimportant. There is also a thannah at Aree and Kharee.

ANNUAL FAIRS.—Annual fairs are held at the source of the Weingunga in the village of Puttopoor in November, at Beesapore in February, at Sureka, the junction of Weingunga and Hirree rivers, in November.

The following list shows the villages at which markets are held:—

MARKETS.—	Donguria	Market once a week.
	Gopalgunj	Ditto.
	Kalulporee	Ditto.
	Kohka	Ditto.
	Jam ...	once a week, in a pucka market place.
	Nugpoora	twice a week.
	Lohara	once a week.
	Nilgee	Ditto.
	Newurgaon	Ditto.
	Mohgaon	Ditto.
	Moosmee	Ditto.
	Jagpoor	Ditto.
	Bagowlee.	Ditto.

CROPS.—The high lands are generally well cultivated and yield good crops of wheat, gram, kodoo, kootkee, jugnee, tillee, oorud, masoor, rice,

theora, and, near the villages where irrigation is resorted to, vegetables and sugarcane.

In the low lands rice and toor are the principal produce.

FOREST PRODUCE.—The jungles and forests of this portion of the district are principally bamboo, mohwa, saj, ebony, dhamun, saleya chiroongee, and teak.

The saj and teak are the timber trees; of the former many fine trees are to be found, but the teak is scarce and generally stunted. Under the forest rules, however, young trees are springing up and promise a fair supply in course of time; a teak garden has been planted near Seetaghirree in the Sonaiwanee Diospyras reserves, and young plants appear to be thriving; there is a very promising belt of fine young trees along the Weingunga river, in the waste lands of Gooreyra, but years must elapse before they attain their full growth.

Mohwa.
Bassa Salifolia.
Saj.
Pentapteree Tomentosa.
Ebony Tendee.
Diospyras.
Dhamun.
Gremia Elastica.
Saleys.
Bosmellia Thurifera.
Chiroongee.
Buchanania Satifoliar.
Teak.
Tectona Grandis.

The bamboos are generally of the smaller kind, but in places along the Weingunga clumps of the large description are met with; these attain to a girth of eighteen inches.

The mohwa is valued for its flower, which yields the common spirits of the country on distillation; it is also dried and extensively used as an article of food by the Gonds and poorer classes of the people. An oil is also prepared from the seed, which I understand is used in the adulteration of ghee. The wood makes a fair building material, but is not used for that purpose in the district, though I have seen it cut into roofing timbers in Oudh.

The ebony grows to a good size, but is little used owing probably to its weight and excessive hardness. I have seen logs of the heart or black wood about twelve or fourteen feet long, straight, and about two feet in circumference. The white wood of young trees is much used for shafts and frames of carts for which it is invaluable on account of its toughness and elasticity.

The dhamun or Indian sance wood attains to a considerable size; it is remarkably springy and elastic, and is used for shafts, banghy poles, and other implements in which its peculiar properties are desirable.

The saleya is one of the commonest trees in the jungle, its wood is useless for anything but burning. It yields a resin very similar to the gunda barosa, Venice turpentine, which exudes from the trunk if previously cut and wounded with an axe. The incense, loban, is also obtained from this tree. The gunda barosa is procurable in all the bazaars, and is considered a useful application to ulcerous sores.

The chiroonjee is very abundant, and produces a very pleasant fruit like a small plum, it is called *achar* by the villagers. The kernel is much used in native cookery, and is procurable in every bazaar and known by the name of chiroonjee.

Fibers and oils may be reckoned amongst the jungle produce, many good specimens of these were shown at the Jubbulpore exhibition.

Tusser cocoons and shell-lac are collected and sold by the Gonds and inhabitants of the jungle tracts. Honey is also abundant.

Kuttia (catechu) extracted from the khair wood (acacia catechu), a very abundant shrub in parts of the district, can also be procured in all bazaars; besides the above are many other products of less importance which it is unnecessary to mention here. Grass for fodder and thatching purposes is procurable in any quantity.

The soil in the northern portion of the season's work is black cotton in the vicinity of the trap formation, and is evidently the result of its disintegration.

In the south and south-east the soil is light and sandy as might be expected, as the formation is principally gneiss and of granite origin. The rugged outline of the granite formation in the south presents a striking contrast to the comparatively smooth flat topped hills to be met with throughout the north of the district, where the trap and laterite is the principal geological features of the country.

It is remarkable that the stone chips, found so abundantly in the vicinity of Jubbulpore, are also met with but in less numbers in several places on the Seonee plateau, notably in the vicinity Lucknadown in the work of season 1866-67.

The survey of district Seonee will be completed during season 1868-69, and I propose, with next annual report of the operations, to submit a more extended report of the whole district.

DESCRIPTION OF COUNTRY SURVEYED IN DISTRICT RAEPORE, SEASON 1867-68, BY R. B. SMART, ESQ., REVENUE SURVEYOR, 2ND DIVISON, CENTRAL PROVINCES.

The tract of country surveyed, in the district of Raepore, during the past season, is situated in the heart of the Chutteesgurh plateau, and may be divided into two divisions, the western and eastern, separated by the Mahanuddy river.

GENERAL DESCRIPTION.—The country to the west of the river is undulating, and in many places it is rocky and stony, and has an average elevation of 900 feet above the sea level, and wherever cultivated, good crops of rice are produced and beyond the demand of consumption on the spot, the exportation of grain has consequently been comparatively very great, and the price of grain is cheaper than in other districts of the Central Provinces. But on whole the land has a poor soil, and is much neglected. In the rainy season there is some pasture, but in the dry season it is exceedingly parched and dismal. Extensive tracts are alleged to be incapable of cultivation. The most productive soil is the black clay in the lowlands; it is most retentive of moisture and good crops can be reached on it. The red soil is not very uncommon and often contains calcareous nodules, so that it is necessary to have a field well dressed, and it requires more irrigation. The plateau is almost destitute of wood, and fuel has to be obtained from long distances. Certain it is, that the want of trees has caused a material alteration not only in the entire face of the district, but in the supply of water. In addition to this cause of the declining water-power of the country, it is

necessary to mention the rapidity with which the land is cleared of rain almost as soon as it falls. The proportion of forest and woodland required for an agricultural country, in order to ensure a regular and sufficient rain-fall without violent storms is estimated by Rentzsch at 23 per cent. Wells are sunk to the enormous depth of 70 feet, before water is obtained. The want of good water, during the hot months, is most seriously felt by all, and much suffering inflicted; the wells dry up, and drinking water is procured from tanks covered with rank vegetation, and deadly epidemics are not unfrequently prevalent. The well waters look clear and sparkling and pleasant to the taste. The sparkling arises from the carbonic acid gas they contain, and the cooling taste from the large quantities of carbonate of lime held in solution, and dissolved by the carbonic acid.

Inhabitants.—The generality of the inhabitants are Chumars of the Sutnami tribe, who were originally hide-tanners and leather-sellers by profession, and have settled down upon the land in large agricultural colonies, and established a religion of their own. The darkest superstition prevails amongst them, and the greatest difficulty is experienced in preventing them from maltreating and murdering old women for witchcraft. The Judical Commissioner in his annual report for 1866 writes that "this belief still retains its hold on the minds of the people. It is always a matter of difficulty, and one requiring time to eradicate religious superstition; but the severe punishments awarded by our Courts in all cases in which superstitious belief has resulted in violence to individuals have not been without effect." This year, the Free Church Mission has sent one of its members to labor among them. Education and religious training will alone raise these people from their dark superstition. If they are not all converted, they will grow up happy, useful, and moral men and women. The Educational Department have established several schools, but they are not in a flourishing state. A desire for English education has not shown itself, and little can be accomplished as long as the school masters are ignorant of the Chutteesgurhee language. Hindoostanee is understood only by the Mowzadars and a few of the chief men of the villages. The village of Bhundar, which is 35 miles north-east of Raepore, on the boundary of pergunnahs Raepore and Lown, is the present seat of the Sutnamee Gooroo Agur Dass, but the people do not look upon him with that reverence that they did on his predecessors. Adultery is looked upon by the Chumars as the greatest sin, but the following remark taken from Captain Twyford's account of the Sutnamee Chumars on the practice of "Sutloke Churna," proves that the men show no concern when their wives commit adultery. "When the wife (bride) comes home, she visits all her husband's relations, and respectable people of the village. Both bride and bridegroom go to the Bhundaree to learn the five names (Punchnam,) and she is willingly left to the Gooroo, or Bhandaree, as the case may be, for a night. The Chumars consider it improper for them to know their wives carnally before the Bhundaree or Gooroo has had connection with them." The following was mentioned to me by the Mowzadar of Rohasee village. On the death of the husband, the widow is considered impure till she knows carnally the first five men who go to her. She is then eligible for re-marriage.

The following is a short table of Chutteesgurhee words :—

CHUTTEESGURHEE.		Oordoo.	English.
English.	Hindee.		
			A.
Chandais ...	छांडदईस	چھوڑ دینا	Abandon.
Hairna ...	हेरना	گھٹنا	Abate.
Boothee ...	बूती	سکنا ۔ قابل	Able.
Heth ...	हेत	عبادت - پوچنا	Adore.
Tengra ...	टेंगरा	زناکار	Adulterer.
Peechkat ...	पीचकाट	تکرار حجت	Alteration.
Amerbo ..	अमरबो	نزدیک آنا	Approach.
Tungia ...	टंगीया	کلہاڑي تبر	Axe.
Chinah ...	चीन्हा	واقف ہونا	Acquainted.
Sungwaree ...	संगवारी	همراہ	Accompany.
Puraijana ...	परायजाना	روپوش ہونا	Abscond.
Teewah ...	टीवा	اِقرار نامہ	Agreement.
			B.
Toora ...	ढूरा	لڑکا	Boy.
Dusna ...	दसना	بچھوانا	Bedding.
Budee ...	बदी	ملامت	Blame.
Peela ...	पीला	طفل	Baby.
Sooghur ...	सुघर	خوب صورتي	Beauty.
Puheelay ...	पहीले	آگے	Before.
Munth ...	मंद	درمیان	Between.
Kuriya ...	करीया	سیاہ	Black.
Burda ...	बरदा	بیل	Bullock.
Boda, Haila ...	बोदा-हेला	بھینسا	Buffaloe.
Purroa ...	पररुवा	پاڑا	Do. calf.
Pothee ...	पोथ	کتاب	Book, small.
Gurunth ...	गरन्थ	کتاب	Do. large.
Bhaee ...	भाई	بھائي	Brother.
Murduniya ...	मरदनीयां	حجام	Barber.
Khoodia-Cheria ...	खुदोया-चरीया	چغل خور	Backbiter.
Goodee ...	गुदी	مغز - بھیجا	Brain.
Bherbhoongia ...	भरभुंगीया	دیوالا	Bankrupt.
Dhekna ...	ढेकना	کھٹمل - مکھون	Bug.
Philphillee ...	फीलफीली	تیتري	Butterfly.

Chutteesgurhee.		Oordoo.	English.
English.	Hindee.		
			B.
Kútri ...	कुतरी	کتي	Bitch.
Dulleea ...	डलोया	ٹوکري	Basket, large.
Churcea ...	चरोया	ٹوکري	Do. small.
Kunheea ...	कन्होया	پشت	Back.
Koorace ...	कुराड़ो	چوب	Beam.
Tharrun ...	धारन	پشه	Buttress.
Khurrab ...	खराब	خراب	Bad.
			C.
Hooth Kuraweh ...	हतकरावे	پکارنا	Call to.
Bader ...	बादर	ابر - بادل - بدلي	Cloud.
Dager ...	दागर	بچهڑا	Calf.
Tam ...	ताम	تانبا	Copper.
Bilaee ...	बीलाड़ो	بلي	Cat.
Peechly, Geh, awe ..	पीछलीगेहआव	پیچھے آنا	Come after.
Kootikurna ...	कुटीकरना	ٹکڑے کرنا۔چیرنا۔قیمہ کرنا	Chopping.
Mirhee ...	मोरची	مرچا	Chili.
			D.
Kupat ...	कपाट	دروازہ	Door.
Mutwar ...	मतवार	متوالا	Drunk.
Konda ...	कोंदा	گنگا	Dumb.
Jhoora ...	झुरा	سوکھا	Dry.
Doormuth ...	दुरमत	جھگڑا	Dispute.
Seethf ...	सीत	شبنم - اوس	Dew.
Bhygni ...	भेएगय	هوچکا	Done.
Kookoor ...	कुक्र	کتا - سگ	Dog.
Chena ...		اُپلي	Dung (dry).
Murgaees ...	मरगाईस	مرا	Dead.
Matee ...	माटो	خاک	Dust.
			E.
Ninghnya ...	नीघगघ	گھوسنا - داخل هونا	Entered.
Gar ...	गार	انڈا	Egg.

CHUTTEESGURHEE.		Oordoo.	English.
English.	Hindee.		
			E.
Binowry ...	बीनोरी	پلک	Eyelid.
Khoosoo ...	खुस्	خارش	Eruption.
Loorhkee ...	लुरखी	مرکي	Earring.
Bhoocean ...	भुर्यां	زمين	Earth.
Sanj ...	साज	سانجهه	Evening.
Oothee ...	उती	مشرق	East.
			F.
Burpaila ...	बरपेला	زبردستي	Forcible.
Cookree ...	कुकरी	مرغي	Fowls.
Sindroop ...	सींदरूप	بچهيرا	Foal.
Dada or Baba ...	दादा, या बाबा	باپ	Father.
Dhoodhra ...	धुधग	کهاسا	Fog.
Bisurdariss ...	बीसरडारीस	بهولنا	Forget.
Gor ...	गोर	پانون	Feet.
Agi ...	आगी	آتش - آگ	Fire.
Kekhree ...	खेखरी	لومڑي	Fox.
Kuppar ...	कपार	پيشاني	Forehead.
Dolee or Khar ...	डोली, या, खार	کهيت - مزرع	Field.
Peesan ...	पीसान	آٹا	Flour.
Sugah ...	सगा	دوست - عزيز	Friend.
			G.
Tooree ...	टुरी	لڑکي	Girl.
Khuder ...	खदर	گهانس	Grass.
Bunay, or Aen ...	बने, या, ऐन	اچها - بهتر	Good.
Bhugwan ...	भगवान	خدا	God.
Buraee ...	बराई	بکري	Goat, she.
Bokra ...	बुकरा	بکرا	Do. he.
Soan ...	सोन	سونا	Gold.
Lassa ...	लासा	گونه	Gum.
Sukelbo ...	सकेलबो	جمع کرنا	Gather.
Topuk ...	तूपक	توپ بندوق	Gun.

CHUTTEESGURHEE.		Oordoo.	English.
English.	Hindee.		
			G.
Fhurka ...	फरका	پھاٹک - دروازہ	Gate.
Mommohowut ...	ममाऊवत	خوشبو	Good smell.
			H.
Kooriya ...	कुरीया	مکان	House.
Dumkee ...	दमकी	ٹیکری	Hill.
Ghoda ...	घोडा	گھوڑا	Horse.
Mudrus ...	मद्रस	شہر	Honey.
Kens ...	केस	بال	Hair.
Moorh ...	मुर	سر	Head.
			I.
Kunther ...	कतर	سود	Interest.
Musiyany ...	मसीयानी	دوات	Inkstand.
Goodee ...	गुडी	مسافر خانہ	Inn.
Muces ...	मद्दीस	روشنائي - سیاهي	Ink.
			J.
Gowria ...	गवरीया	گاروڑي	Juggler.
Kolia ...	कुली	گیدڑ	Jackal.
Bunraj ...	वनरज	جهاڑي	Jungle, large.
Jharee ...	झारी	جهاري	Do. small.
Goodgoodain ...	गुडगूडचैन	مزاخ - مسکري	Joking.
			K.
Koochy ...	कुची	چابي	Key.
Chakee ...	चाकी	گھٹنا۔ زانو	Knee.
			L.
Lobry ...	लवरी	جهوٹ	Lie.
Munth ...	मद्द	شراب	Liquor.
Mungta ...	मगंटा	رچهه - انگڈا	Loom.
Khutwa ...	खटवा	کهنڈا	Log of wood.

CHUTTEESGURHEE.		Oordoo.	English.
English.	Hindee.		
			M.
Duwka ...	ढवका	آدمي	Man.
Battoor ...	बादुर	بہت	Much.
Wusha ...	वासचा	دوا	Medicine.
Goosunya ...	गुसंया	مالك	Master.
Buhiya ...	बहीया	دوانہ	Mad.
Chunda ...	चनडा	چاند - ماہ	Moon.
Dayee ...	दाई	والدہ - مان	Mother.
Maycha ...	मेछा	مرچھیں	Moustaches.
Chocho ...	छुछू	چچوندري	Muskrat.
Bendree ...	बेन्दरी	بندر - بوزنہ	Monkey.
Jantha ...	जांता	چکي	Mill.
Soondur ...	सुदंर	خوبصورت - خوشنما	Man, Handsome.
Pundhra ...	पण्डरा	گورا	,, Fair.
Mundul ...	मनडल	دولتمند	,, Rich.
Kungal ...	कंगाल	غریب	,, Poor.
Bulwala ..	वलवाला	قوتمند	,, Strong.
Dhoomra ...	धुमरा	مضبوط	,, Stout.
Sookra ...	सुकरा	دبلا - حقیر	,, Thin.
Dhahurwa ...	धहरःवा	ترچھا	,, Squint-eye.
Bootra ...	बुटरा	چھوٹا - کوتاہ	,, Short.
Doongwa ...	डुगंवा	اونچا	,, Tall.
Koondwa ...	कुदंवा	گنگا	,, Dumb.
Bhupra ...	बपरा	چپ - خاموش	,, Quiet.
Koorwa ...	कुरःवा	لنگڑا	,, Lame.
Bahira ...	बहीरा	بہرا	,, Deaf.
Sunkra ...	संकरा	صبح	Morning.
			N.
Tankee ...	टांकी	کھیلا - میخ	Nails (Iron).
Bhongra ...	भागंरा	نتھنا	Nostril.
Muzhniya ...	मझनीय	دوپہر	Noon.
Bhundar ...	भडर	شمال	North.

CHUTTEESGURHEE.		Oordoo.	English.
English.	Hindee.		
			O.
Goondhlee ...	घुंघली	پیاز	Onion.
Oppoo ...	ओपु	آفیم	Opium.
			P.
Moondaysa ...	मुंडेसा	تکیه	Pillow.
Khulenee ...	खलेनी	جیب	Pocket.
Thupolee ...	थपोली	پنجا	Paw.
Munjoor ...	मनजुर	مور - طاؤس	Peacock.
Burha ...	वरहा	سور	Pig.
Woopkana ...	वुपकाना	کھینچنا	Pull.
Chongee ...	चोंगी	چلم	Pipe (Tobacco).
Buraech Baree ...	वराईवारी	تانڈو پانکا	Pan-garden.
			R.
Dahur ...	डाहर	راسته	Road.
Nudiya ...	नदीया	ندي	River.
Soortawun ...	सूरतावन	آرام	Rest.
Punjree ...	पंजरी	پهسلي	Rib.
Woozarna ...	वुझारना	مٹانا	Rub-out.
Chyrra ...	छेरा	بو	Reed-grass.
Moondree ...	मुंदरी	انگوٹهي	Ring.
Dour ...	डोर	ڈوری - رسي	Rope.
Purwa ...	परवा	چهپر - کلبه	Roof.
			S.
Lowree ...	लवरी	چهڑی - لکڑي	Stick.
Pukhna ...	परवना	پتهر - سنگ	Stone.
Khilna ...	खीलना	سیا	Sewing.
Tant ...	टांट	مضبوط	Strong.
Soaj ...	सोज	سیدها	Straight.
Chundaynee ...	चन्देनी	ستارہ	Star.
Koosiyar ...	कुसीयार	گنا - اونك	Sugar-cane.
Soorooj ...	सुरज	آفتاب	Sun.

Chutteesgurhee.		Oordoo.	English.
English.	Hindee.		
			S.
Koodar ...	कूडार	نالا - نهر	Stream.
Dhodgee ...	धाडकी	جهدرة	,, small.
Buhince ...	बहोनी	همشيرة	Sister.
Roop ...	रुप	چاندي	Silver.
Milkee ...	मीलकी	اشارا كرنا	Suggest.
Pyra ...	पैरा	پرال	Straw.
Panáin ...	पनयां	جوتي	Shoes.
Bhadain ...	भादेन	چپل	Sandals.
Rapa ...	रापा	پهاوزة	Spade.
Machowlee ...	मचौमी	مورّها - مچيا	Stool.
Kotee ...	कोटी	كوٹهي	Store-house.
Kurchul ...	करछल	چمچا	Spoon, Iron.
Noon ...	नुन	نمك	Salt.
Máhur ...	मेहर	موچي - چمار	Shoe-maker.
Rawut ...	रवत	چاپان - گررّيه	Shepherd.
Bhoorthee ...	भुरती	مغرب - - سورج است	Sunset.
Ruxhown ...	रुखोन	جنوب	South.
Khurra ...	खरा	استاده - كهڑا	Standing.
Baesa ...	बईसा	نشست	Sitting.
Busath ...	बसात	بدبو	Stinking.
			T.
Rookh ...	रुख	درخت	Tree.
Chandny ...	चडंनी	تمبو - ڈيرة	Tent.
Thuriya ...	तरीया	تلاب	Tank.
Jhokna ...	झोकना	لينا	Take.
Makhoor ...	माखुर	تنباكو	Tobacco.
Tonta ...	टोडां	حلق	Throat.
Tehanleh ...	ताहाले	تب	Then.
Gootiyana ...	गुटोयाना	بول چال	Talk.
Sirto ...	सीरतु	سچا	True.
Umraee ...	अमराई	باغ	Tope.
Dubree ...	डबरी	ڈبرا	Tank, small.
Rendheca ...	रेंधोया	باتوني - دريده دهن	Talkative.

Chutteesgurhee.		Oordoo.	English.
English.	Hindee.		
			U.
Chatringee ...	छतरेगी	چھاتا	Umbrella.
			V.
Wochy ...	वछे	قي	Vomit.
Kala Baree ...	काला.वारी	ترکاري	Vegetable garden.
			W.
Bootha ...	बुता	کام	Work.
Dowkee ...	डवकी	عورت - مستورات	Women.
Gura ...	गरा	هوا - باو	Wind.
Kaber ...	कावर	کیون	Why.
Shakhee ...	साखी	گواهي - شاهدي	Witness.
Sooyin ...	सुईन	دائي - دودہ پلاني	Wet-nurse.
Alchee ...	ऐलची	زخم	Wound.
Rengat ...	रेगांत	پیدل چلنا	Walking.
Bheethee ...	भीती	دیوار	Wall.
Khootar ...	खुटार	ٹٹي	,, enclosure.
Bhoorthee ...	भुरती	مغرب	West.
Bureat ...	भरेट-वजीर	دھوبي - گازر	Washerman.
	Short Sentences.		
Ja ga ...	जागा	جاو	Go.
Ach lala ...	अचेलाला	او	Come.
Agoer la ...	अगोरले	ذرہ ٹھہرو	Wait a little.
Hooth kurroo ...	हुक्करो	پکارو	Call out.
Kaes ga ...	कइसगा	اجي	I say.
Chongee bhur, pee-boo ...	चोंगीभरपीवो	چنگاني بھرومین پیونگا	Fill a pipe, I shall smoke.
Gorh doha bur panee da nonee ...	गोरधुवावरपानीदेनो नो,	ای بیٹي مجھے اپڑاون دھونے پاني دو	Daughter, give me water to wash my feet.

Chutheesgurhee.		Oordoo.	English.
English.	Hindee.		
Kooch ka ha bur hai tho ka ha da ba	कुछ काहावरहरै लो कहदेवा	کچھہ کہناھوتو کہو	Have you any thing to say to me? Say it.
Panee bur ja huthun thuraeea ...	पानीभरजातहनतरी या,	تالاب سے پاني بھرلانے جاتے ھیں	Going to fill water from the tank.
Kown maer thaen jath huss ..	कौनमेरतयंजातहस,	کس طرف تم جاتے ھو	Which way are you going?
Bearee ka buckuth bahees ...	वीयारीके वखतभईस,	کھانے کا وقت ھوا	It's time for meal.
Munkah jhugra kurhuthun ...	मनखेझगराकरतहन,	لوگ جھگڑتے ھیں	Men are quarrelling.
Thaen buheea hus	तयं वहीयाचस,	تم دیوانے ادمي ھو	You are a mad man.
Mo lah uskut lagis	मोहले असकटलागीस,	میں تھکا ھوں	I am tired.
Eh hur kooch hae niee jah na ...	ये हरकुछ हे नीजाना,	وہ کچھہ نہیں جانتا	He knows nothing.
Ek munkah la mardaris gown ma	ऐकमनखालामारडा रीगांवमा,	گاؤں میں ایك شخص مارا گیا	A man has been murdered in the village.
Khurka churaee bur la jath hun ...	खरकाचरादीवरलेजातहन,	گوروکو چرنے لیجاتا ھوں	Taking the cattle to graze.
Kithee iek dooreea ja ba ...	कीतीऐकदुरीयाजावा,	تم کہانتك جاوگے	How far are you going?
Thaen lurwa hus ...	तैलंरवाहस,	تم احمق آدمي ھو	You are a stupid man.

MINERALS TRAP.—The most predominant rocks appear to be of the nature of whin or trap, compact limestone and coarse sandstone. The trap rocks are devoid of any visible stratification. The rock is going fast into decay, and in some places the decomposed mass has lost all traces of its origin, and has become a dark brown soil.

LIMESTONE.—The limestone is seen to advantage in the beds of streams and particularly in the Mahanuddy river, where immense slabs are exposed in horizontal strata; the grains being perfectly impalpable, and the fracture conchoidal, while it emits fire when the rock is struck with a hammer. It is in general of a blue or dark grey color. When it is burnt the lime has an earthy appearance, and it is never perfectly white. From the earthy appearance of the lime, it is believed the rock contains a large quantity of clay (argillaceous limestone), although it makes a strong resistance to the hammer. An inferior kind of magnesian limestone is to be seen a few miles to the north of Raepore.

CLAY.—A few feet below the surface soil, a clay very like *khari* or *geru*, occurs of various parallel layers of different colors, but generally of an earthy white. It is a little harder than chalk, and has a soft greasy feel, nor does it adhere to the tongue, but which, on exposure to the air, becomes somewhat hard. It is used by the natives to whitewash the walls of their houses and huts, and adds to the appearance of the country. Pregnant woman eat it in small quantities and boys rub it with water into a white liquid with which they write on boards or leaves.

PRODUCTIONS.—The productions are, rice, sugarcane, and a little cotton. Rice and cotton are the principal articles of export; hardware and English piece-goods are among the imports. The traffic is carried on by country carts and pack-bullocks, and commences in November, carrying the grain stored from the preceding harvest. Empty carts are driven from distant markets for the purpose of conveying the grain.

RIVERS.—The principal and only river is the Mahanuddy. It takes its rise near the village of Seehawa and enters the district a little to the south-west of Dhumtary, and runs through pergunnahs Dhumtary, Raepore, Seerpore and Lown, till it receives the Seonath river at the north-east extremity of the district; the river then flows to the eastward, and after passing Sumbulpore and Cuttack falls into the Bay of Bengal near Pooree. After a long and winding course, and before its junction with the Seonath, it receives numerous tributary springs. The following are the principal ones: Soondhoor nullah, Surgee nullah, Sukwa nullah, Koorar nullah, Nainee nullah, Sukma nullah, and Balumdi nullah. The bed of the river is rocky, exposing extensive beds of blue limestone in horizontal strata, containing from December to May, many fine pools of clear water, although nearly stagnant. The river is fordable during the dry months of the year, but during the rains the channel is filled and has a rapidity that is eminently unfavorable to commercial utility. The junction of Mahanuddy and Seonath has an elevation of 770 feet above the level of the sea. The fall is 4·75 feet in one mile.

EASTERN DIVISION.

GENERAL DESCRIPTION.—The tract of country to the east of the Mahanuddy consists of hills and forests; the valleys are watered with clear streams, but the country is grossly neglected, and almost in a state of

savage nature. On the Mahanuddy the culturable waste is generally interspersed with rice cultivation. The hills are of comparative little elevation, and although their sides are perhaps still more abrupt than is usual towards the east, their summits are level. Towards the west the gradual slopes are rocky, on which are scattered tufts of long grass and stunted bushes of the most parched appearance. The eastern sides are very difficult of access, in some places the perpendicular wall rises to the very summit, and at the bottom the surface consists of confused fragments of rock, generally, however, intermixed with a good deal of soil, and covered with trees and bamboos; neither grow to a magnificent size. In the dry season everything, however, is parched and dismal, nor is their savage ruggedness enlivened by the clear and winding streams. In the rainy season the verdure of the trees and the roaring of the torrents swollen to a tremendous power, must render these recesses truly magnificent, but then they are the abode of disease, and from the enlargement of the torrents are scarcely penetrable.

Principal Hills.—The most remarkable hills are the following with their elevations above the sea level:—

Hills.	Above the Sea level Feet.	Latitude.	Longitude.	
		° ′ ″	° ′ ″	
Murpar	1,580	21 26 7	82 26 10	Extracted from Colonel Saxton's map.
Ganjimal	1,516	21 23 29	82 23 32	
Hardi	1,424	21 22 20	82 30 08	
Bamandei	1,284	21 23 5	82 32 42	
Mandi	1,500	21 27 39	82 31 54	
No. 1	1,420	21 17 34	82 25 12	
No. 2	1,551	21 26 2	82 33 50	

Reserved Forests.—The reserved forests are situated at the south-eastern portion of this tract (pergunnah Lown); their limits are not permanently demarcated, but the "people of the country understand the rules and make no attempt to tresspass into, or in any way to injure, the reserves." The timber is too far from roads and markets to repay any attempts to work it. No trees are felled save under the special direction of the officer in charge, and the right to collect miscellaneous forest produce, such as gums, fire-wood, lac, wild silk cocoons, bamboos, and grass, is annually leased out. The strictness of the rules has been relaxed in favor of the Bunjarras (pack-bullock owners) travelling through the forests. The reserves consist principally of sâl (Shorea robusta) trees. Amongst these sâl trees are found a sprinkling of ebony trees, muhoa, surrie, dhaora, saj, seesum, tewsa, kurna, dhamun, and a few others. Bamboos are only found on the hills to the northward.

Rivers.—The Mahanuddy river is the receptacle of all the numerous streams that flow westerly. The following are the principal ones: Dauli, Balumdi, Kusmi, Sukla, Makmala, and Naini. The Kantara and Muraedoa

flow easterly into the Jong river. The water-shed has an elevation of 955 feet above the sea level.

CIVIL STATION OF RAEPORE.

RAEPORE.—Raepore, the sudder station of the district of Raepore, is situated in the centre of the Chutteesgurh plateau, in latitude $\frac{21°.14'}{22°.59'}$ north, longitude $\frac{81°.41'}{42°.38'}$ east, and has an elevation of 943·84 feet above the sea level.

It contains about 30 bungalows and 4,934 huts, with a population of 13,887 souls; of this number only 227 are agriculturists.

As the head-quarters of the Chutteesgurh division, the public buildings are, the court, civil and criminal, of a Commissioner; Deputy Commissioner's court, jail, charity hospital, Protestant church, and school of arts.

A Regiment of Madras Native Infantry is stationed here. This regiment is under the orders of the Brigadier General commanding the Kamptee force.

The roads about the station are very good and well bridged.

* The Bhoora tank is the most ancient in the place, and is said to have been formed nearly 500 years ago.

The Maharajee tank was originally a swamp, a bund was built about 100 years ago by Maharaj Danee. The construction of this bund changed the swamp into a fine tank. To the south of the tank is a temple to Ramchundra, built and endowed A. D. 1775, by Bibajee Bhonsla, Rajah of Raepore.

The Khoko tank is the most substantial in the place, and was built by Kodnud Sing, Kumaishdar of Raepore, about 40 years ago.

Amba tank is supposed to be about 200 years old, and was thoroughly repaired and faced with massive stone terraces, and steps to the water on three sides; this work was done at a cost of Rs. 10,000 by Soobaram Mahajun.

The Rajah tank was built by Rajah Burriar Sing 200 years ago.

Kunkalee tank, in the middle of the city, was built of stone throughout about 200 years ago by Kirpal Gur Mahant, who also built a small temple to Mahadeo in the middle of the tank.

Cotton and grain are principal articles of export; the precious metals are the chief imports; hardware, cocoanuts, and sugar are also imported to a considerable amount.

Raepore was a place of little note till about A. D. 850, when a branch of the Ruttunpore king's family came and established his court. The Rajpoot rule was overthrown by the Maharattas A. D. 1745; the old fort was dismantled and Ruttunpore again made the seat of Government. In 1818 the country was placed under British superintendence, and Colonel Agnew, the first Superintendent, finding Raepore a more suitable and healthy locality than Ruttunpore, removed to it. In 1830 the country was again made over to the Mahratta Government, and Soobahs from Nagpore governed in Raepore till A. D. 1854 when the district was

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* Abridged from the *Central Provinces Gazette*.

finally annexed to the British territories. From that time security for property and confidence in the Government began to arise and the town gradually increased.

LEAD ORE.

Copy of letter No. 138, *dated Calcutta, 2nd July* 1868, *from* THOMAS OLDHAM, ESQ., *Superintendent, Geological Survey of India, to* COLONEL J. E. GASTRELL, *Deputy Surveyor General.*

I have the honor to acknowledge receipt of your letter No. 331, dated 18th ultimo, forwarding copies of letters from Mr. R. B. Smart, together with a package containing specimens of ore referred to in them, and requesting a report on these.

A specimen of precisely similar ore had been received some time before from the Deputy Commissioner of Raepore, and I would quote a part of my letter in reply, dated May 14th, 1868.

"The ore is galena, or the sulphide of lead (sulphur and lead); it occurs in crystalline masses imbedded in greenish fluor spar forming a vein with quartz. Galena is a valuable ore of lead, and often yields also a large percentage of silver. The specimen in question does not contain much silver. But it is impossible to form any estimate whatever of the value, that is, of the commercial value of a metallic vein or lode from hand specimens. This depends entirely on the amount of ore, the facility of working it, the position of the mine, &c., &c., points which could only be determined after a careful examination of the locality itself."

The specimens submitted with your letter enable me to add to this, that the fluor spar is more abundant than at first appeared to be the case, and is even more frequently of a rich purple than of a green color.

The ore from these specimens has also been cupelled on a larger scale than before, but with the same result; the amount of silver present though appreciable is not sufficient to be of any practical value.

There is no antimony in the specimens submitted, as supposed by Mr. Smart.

The specimens from Mr. Smart's account would seem to have been derived from loose blocks of stone, imbedded in earth. There is no question, however, that they form a portion of a regular vein which must have existed, where these loose blocks were derived from, and in all probability at no great distance from the spot where they occurred. It would be desirable to trace out this lode or vein, and ascertain its value.

I may add that both as to rock and gangue the vein looks decidedly promising and may be of much value.

I shall be obliged by being favored with any further information regarding the lode which may reach your office.

No. 60.

OFFICE MEMO.

Forwarded to R. B. Smart, Esq., Revenue Surveyor, 2nd Division, Central Provinces, with a request that he, on again taking the field, will examine the spot more closely, and if possible trace out the vein and give

such further information as is required and indicated by Dr. Oldham in the concluding paras. of his letter; a sketch survey of the locality might also be of use. The dip of the vein should be given if possible.

SUPDT. OF REVENUE SURVEY'S OFFICE; UPPER CIRCLE, *Calcutta, 3rd July* 1868.

J. E. GASTRELL, *Colonel, Deputy Surveyor General.*

The lead ore was accidentally discovered by the beldars working on the road between Bhundara and Raepore. Whilst engaged surveying the district of Raepore, I was requested by Captain Twyford, the Deputy Commissioner, to visit and give my opinion upon the vein.

Specimens were forwarded to Colonel Gastrell, Deputy Surveyor General of India, and to the Chief Commissioner, Central Provinces.

The hills on which the ore is found are situated in the lands of Khyragurh and Nandgaon zemindarees, and three miles to the west of Chichoolee dâk bungalow, near the village of Ranectalao, and consists of large masses of quartz imbedded in rich black earth. The metal runs through the quartz in veins and nests. The hills run north and south and have a most arid and sterile appearance. The land is undulating and profusely studded with fragments of rocks. The surface soil is of a dark color and derived from the decomposition of the various and numerous rocks in the vicinity of the spot. The streams which flow to the east fall into the Seonath river; those flowing to the west into the Bang nuddee. The jungle on the hills principally consists of the following trees, sullaie, ghoteea, kakaie, pursa, saja, renwa, and millee.

DESCRIPTION OF COUNTRY SURVEYED IN DISTRICT CHANDA, SEASON 1867-68, BY LIEUT. F. CODDINGTON, REVENUE SURVEYOR, 4TH DIVISION, CENTRAL PROVINCES.

GEOGRAPHICAL POSITION OF COUNTRY SURVEYED.—As stated in the body of the accompanying report, the portion of the Chanda district surveyed this season lies between the parallels of 19° 46′ and 20° 22′ of north latitude, and of 79° 07′ and 80° 02′ of east longitude; the extreme length north and south is about 30 miles, and extreme breadth east and west about 56 miles, and contains an area of 1116·18 square miles.

SOIL AND CROPS.—To the south, south-west and east, along the rivers Urda and Weingunga, is found the black cotton loam soil, producing good crops of cotton, grain, and pulse; wheat appears only in small quantities, and the cotton is chiefly grown for home consumption. Where small spaces have been cleared in the jungle for cultivation the soil appears very poor, and rice may be said to be the principal crop thereupon raised. It is sown year after year, with little or no manuring during the rains, so that the ground naturally becomes exhausted and impoverished; towards the hills the soil becomes generally reddish and more sandy. The inhabitants are lazy and make next to no attempt at irrigation, which in many places could be resorted to with advantage.

MAIN CIRCUITS 13, 14, AND 15.—The eastern portion of the work is that included in main circuits Nos. 13, 14, and 15; these main circuits very nearly embrace the portion of the country that was originally

called pergunnah Rajgurh, but the pergunnah divisions having been done away with throughout these provinces, the old pergunnah now forms a portion of the tehseel of Mhool. This is the portion of the country I will first enter into a slight description of.

General Appearance of Country.—The general appearance of this country is undulating, small hills and small ranges of hills being dotted about; the general scenery, as long as the cold season lasts, is most pleasing to the eye, but as soon as the hot weather sets in as a rule, all the trees lose their leaves, and the whole country assumes a brown burnt up aspect, similar to the ordinary plains of India, excepting those parts in the immediate vicinity of water which still remain green.

Chief Villages.—The following are the only villages worthy of note, *viz.*, Mhool, Sowlee, Wehar, Rajgurh, Marora, and Rajuli.

The chief village or Kusba town of the tehseel is Mhool from which the tehseel takes its name; the head quarters of the tehseel are situated there under a tehseeldar. It is situated in about latitude north 20° 05′ and in longitude east 79° 43′; the site contains about 800 huts, covering an area of 60 acres. It has a boys' as also a girls' school. Octroi is levied in the village, and a large weekly bazaar is held every Thursday; there is also a police station and a post office. A large tank lies to the south-west of the village site in which are fish and wild fowl.

Sowlee is the next village of importance; it lies about seven miles almost due east of Mhool, and contains also about 800 houses. A good trade in cotton cloths and silk is carried on at the large weekly bazaar which is held there; it contains a school for boys.

Wehar is a village prettily situated about fifteen miles to the east and a little north of Mhool. Mr. G. Barrett thus describes it: "As one of the prettiest villages in this part of the country, it is situated on two small hills between which is a large tank. The view from the top of the adjoining hills of the surrounding country is most prepossessing: a vast *spread* of jungle is seen lying to the south and west, and on the other sides a wide *spread* of cultivation, dotted with small villages and topes of trees, with the winding course of the Weingunga river to the east, and various hills in the distance render the scene quite picturesque."

Rajgurh is the village from which the late pergunnah of that name derived its name; it is about four and a half miles to the south-east of Mhool; a large weekly bazaar is held here, but it is a village that has dwindled down in importance; there is a fort in ruins on the adjoining hill above the town.

Rajuli is worthy of remark on account of its magnificent tank or artificial lake which covers an area of 350 acres; the tank is formed by a bund enclosing the natural hollow between the hills; the depth of the water in the centre is said to be as much as eighty feet; the bund is but a small one, in length about 400 feet and about 40 feet high.

Dongurgaon is also remarkable for a very large artificial tank formed by a strong bund, more than half a mile in length, and encloses a sheet of water covering 260 acres.

Minerals.—Iron is generally found over the district, and there are copper mines in existence in the village of Thannah Wasa, situated in a

small hill close to the site; several mines were opened, but as the amount realized was hardly sufficient to pay the labor, the working of them has been given up.

Police Stations.—There are police stations at Choorool and Barsagurh in addition to Mhool.

Chief Rivers.—The only rivers of any importance are the Weingunga, the Mhool, and the Pathree nuddee; the Weingunga skirts the whole of the eastern portion of the season's work; its average breadth is about half a mile; its bed in parts is exceedingly rocky, the banks high, and generally well defined, there are some good fish in it, and by reason of the many small rapids I should say would be most favorable for sport. In the hot season tigers often take up their abode in the high rushes in the bed of the stream; it is not navigable nor could it be made so.

The chief ghâts or ferries along the portion surveyed this season are at Boremarra, Niphundra, Sonapore, Hurama, Sakhree and Chorool, but it is also crossed at several other points when the water is low.

The Mhool nuddee rising up near the village of Chimoor enters by the north of main circuit No. 14, and after flowing nearly due south joins the Andaree at a small village by name Jam, from whence these two streams bear the name of Andaree.

The Pathree nuddee flows out of main circuit No. 12 of last year's work, and joins the Mhool nuddee a few miles south-east of Mhool.

These two latter nuddees derive their names from the two villages of the same name near which they each pass.

Roads.—There are no roads of any importance through this part of the district; there are several cart tracts passable in fine weather only: the chief of these are from Mhool to Gurchooroolee and from Mhool to Chumoorsee.

Main Circuits, Nos. 16, 17, and 18.—The western portion of the tract surveyed is enclosed in main circuits Nos. 16, 17, and 18, and formed pretty nearly the old pergunnah of Havelee, which, like Rajgurh, is now part of Tehseel Mhool.

General Appearance of Country.—These main circuits have even more jungle and of a heavier description than those to the east above described. A very large tract of forest extends continually from Mhool to Chanda, a distance of thirty-two miles east and west and from north to south of the season's work. To the west of Chanda city, and along the Wurda river, there is a tolerable extent of cultivation; the country is undulating.

Chief Town.—Chanda, the capital of the district, is situated in north latitude 19° 57′ and east longitude 79° 20′, on the left bank of the Eerai nuddee which flows not far from its walls, its banks not being well defined and the river subject to great freshes during the rains, its water often comes up to the walls and has at times forced itself inside of them. The Jhurput nulla also runs close past the city on its eastern side. The city is surrounded by a strong well built cut-stone masonry fortress, which consists of small semi-circular bastions joined together by lines of stone parapet forming in some parts entering and in others re-entering angles; the whole is loopholed at top for musketry with a good banquette forming a road of communication round the entire fort of

108249

about 10 feet wide; the general thickness of the parapet at top is about 3½ feet and about 10 feet at base, and average height about 17½ feet. The circuit of the walls of the fort is 5½ miles; the walls are kept in capital repair. There are four principal gate-ways or entrances, through each of which there are approaches for wheel conveyances; they are all handsomely constructed and about 30 feet in height; there are several other minor entrances available only for foot passengers, the names of the gates are "Jutpoora" on the north, by which the imperial road from Nagpore enters; on the south "Puttan," on the east "Achuleswar" or "Mahakalee," on the west "Beeba"; the chief portion of the city lies inside of the fort. A new metalled road is in course of construction which will form a direct road of communication between the Jutpoora and Puttan gates; all the roads inside the fort are metalled and well kept. There is more space within the fort walls than is ever likely to be required for dwelling houses; a great portion is at present given up to cultivation and gardens; on the north-east side of the fort is a large tank called Ramalla; one side of this tank is formed by the walls of the city which form its bund; on this side the walls have also a wide parapet of earth thrown up on the interior side to strengthen them. The tank would always form a good reservoir of water and there are many good pucka wells besides.

The general appearance of the city, viewed from the outside, is exceedingly picturesque, there are some splendid trees in its vicinity as also inside. It contains many temples, but by far the principal one is Mahakalee, situated outside the walls, in the vicinity of which a large annual fair is held in April.

At Lalpet, one of the suburbs of the city, are some stone gods formed each of one piece of stone, the largest of these idols is 31 feet 6 inches high, 21¼ feet broad, and about 2½ feet thick, this one has fallen down.

The following buildings are to be noticed, the school, the dispensary, and the jail which was formerly the citadel of the fort.

There is a dâk bungalow for travellers near the Mahakalee temple, a very inconvenient and disagreeable position for it, and much out of the way.

Chanda Civil Station.—The civil station contains the head quarters of the district, and is situated to the north of the city, the public buildings in it are the Deputy Commissioner's cutcherry, chief district police station, and lines for the wing of a Native Regiment. There is a wretched place called a post office, but it is not worthy of the name. The telegraph office has been shut up, as it was so little used. A church is to be built, but there appears to be some difficulty in deciding about its exact position, and so its erection is delayed, although the necessary funds are, I believe, available. There is a small public garden between the city and military lines called the Nugeena bagh.

Chief Villages.—The principal villages are Bullarpore, Kotaree, Sengaong, Dewaree, and Kebzur.

Bullarpore is picturesquely situated on the left bank of the river Wurda, about seven miles from Chanda in a south-eastern direction; near the village immediately above the river is the ruins of a masonry fort, evidently of the same time and description as the Chanda fort, built

also of cut stone, near this is also an English-looking bungalow without a roof, the bungalow was never completed, and is the property of the firm of Watson and Co., who proposed working a cotton press at Bullarpore, but their agent, to whom they entrusted the work, spent far more than was meant in the construction of the house, and so the undertaking was abandoned, and the house never finished; but as far as it went, it was admirably constructed.

Kebzur is the chief village on the line of road between Chanda and Mhool; it is of no great importance otherwise, except it be that it had for four years previous to April last, a man-eating tigress continually in its vicinity, and who carried off many of its inhabitants, both men, women, and children, so much so that she got the name of the Kebzur tigress; I was fortunate enough to shoot her in April last, thus relieving the country of a terrible scourge; such a fear had the people of this portion of the road, that it was only in gangs and between the hours of about 10 and 4 daily that they would pass at all, and then often one of their number was carried off by her. The night but one after she was shot, they were travelling that same road by night; by reason of this brute another whole village became deserted by every single one of its inhabitants.

Minerals.—Coal, though of rather an inferior quality, has been known to exist in this portion of the district near the villages of Chandoor and Ghoogaos, nearly due west of Chanda, on the river Wurda for some time past. But this year it has been found to exist close to the city of Chanda where some extensive operations in boring have been carried on, and a good seam pierced about 100 feet below the surface of the ground; it seems likely that this coal will some day be found to exist in sufficient quantities to warrant its being worked.

Lieutenant Smith remarks that—"I noticed a good deal of sulphuret of iron in the pieces I picked up." A coal seam of some size also exists on the south side of the Wurda a little below Bullarpore. The sandstone of the district is remarkable for its fine quality, and the stone carvers in Chanda have been very successful in having produced some good specimens of workmanship therefrom in the shape of tables, &c. Iron ore is also generally found.

Trees.—The trees in the jungle will be found to be as follows:—tamarind, cheronjee, tenbroo, kaitta, khairnee, oula, buhera, kalla-behla, dhoura-behla, mowah, (or butter tree), bamboo, khair, googal, neem, sembul, (cotton tree), pulus, bail tree.

Bamboo has been met with in large quantities, it exists along the edges of the larger nullahs in very dense thickets, and forms in many parts the lairs of tigers and other wild animals. In main circuit No. 16, the bamboo especially exists in large quantities, and a considerable trade is carried on in them during the months of April and May. A cart load cost but 12 annas, and sometimes as many as 50 carts have left Kholsa loaded with them in a single day.

Teak saplings are also occasionally met with; the mowah exists in large quantities.

Police Outposts.—Police outposts exist at Kutaree, Eesapore, Chichpiellee, Bullarpore, Kebzur, and at Chowkee (on the Mhool road).

ROADS.—The new imperial metalled road from Chanda to Nagpore passes through the west of the season's operations, this road is yet deficient of many bridges which are necessary to make the road available for traffic during the rains. The Eerai nuddee and other streams are yet not bridged, all the other roads in the district are merely fair-weather ones, and consists of cart tracks; the principal of these is the one from Chanda to Mhool; no road has ever been made, but the jungle is cleared for the space of about two chains wide; another leads from Chanda to Seroncha, this road passes by Bullarpore and Kutaree, a third leads from Chanda to Wone (in Berar), and a fourth from Chanda to Chimoor.

TELEGRAPH LINE.—A line of Government Telegraph runs along by the new imperial road from Chanda to Nagpore; passing Chanda, this line extends to Seroncha; the old line that followed the road to Chimoor has been abandoned.

TANKS.—The only tanks of importance are the Ramalla at Chanda, area = 74 acres of water in May, one in Dabgaon, and one in Junona, the area of the latter is 174 acres, and it is remarkable for its fine masonry bund built by one of the Chanda Rajahs.

STREAMS.—The principal streams are the Wurda, the Eerai, and Andaree; the Wurda runs all along the south and south-west portion surveyed and forms there the boundary of the district; it is a slow running stream with lots of water and sandy bottom, its banks are well defined, but much intersected with deep ravines and nullahs.

The Eerai enters main circuit No. 17 at the north, and flows nearly due south till it joins the Wurda about 4½ miles south of Chanda.

The Andaree enters main circuit No. 16 from the north, and flows in a south-easterly direction through a continuous forest of jungle.

HILLS.—The only hills of importance are those to the north-east corner of main circuit No. 16, known as the Mhool hills, and are the favourite resort of all kinds of wild animals: many streams of beautiful clear water run out of these hills, but it is very unwholesome to drink in spite of its appearance.

INHABITANTS.—The chief inhabitants in the cultivated parts are Maharattas, and in the jungles Gonds; the latter are a primitive race, not fond of hard work, and will eat anything in the shape of flesh; they consumed at Kebzur the whole of the flesh of the tigress I shot, although they knew perfectly well that she had devoured several of their kith and kin.

DESCRIPTION OF COUNTRY SURVEYED IN DISTRICT KAMROOP, SEASON 1867-68, BY LIEUTENANT A. D. BUTTER, ASSISTANT REVENUE SURVEYOR IN CHARGE 1ST DIVISION, LOWER PROVINCES.

Northern Dooars of Kamroop.

The Northern Dooars of Kamroop are chiefly flat ground, covered with tall grass jungle, with patches of cultivation; the further south, the more cultivation. They are bounded on the east by the Bor nuddee, which divides Kamroop from Durrung; on the west by the Monas, which is the boundary of Gowalpara; on the north are the Bhootan hills, which in Dooars,

Baskah and Gurkulah rise from the flat plains in a sufficiently sharp and distinct manner. In Bijnee and Chappagooree the ground rolls considerably under the foot of the hills, so that the edge of the plains is not so easily defined. There is a fringe of forest along the foot of the hills, as a rule, and scattered patches of the same in the Dooars, of which, however, they are not the characteristic feature.

Roads.

2. An imperial road connects Tumboolpore, where there is a police station, with Gowhatty; and it is continued to Durrunga, whence a path leads to Dewangiri. There is also a district road from Tumbulpore to Bojalee.

Rivers.

3. A large number of streams, issuing from the hills, flow irregularly from north to south across the country. Most of these have this peculiarity, that in the dry season, near the point where they debouch from the mountains, they suddenly become dry, the river apparently sinking into the ground. The bed, however, becomes full of water again a mile or so further on, and thence flows steadily all the year round. During the wet season, the whole bed of the stream is full; and it is observed that, as the dry season approaches, it is the most southern point of what eventually is the dry portion of its bed which becomes dry first; the water flowing a shorter and shorter distance from the north, until frequently all its course, visible outside the hills, is quite dry. The points from which the various streams refill their beds are defined in villages Takee and Jobla by a broken strip, or series of patches of forest. Of the rivers which flow continuously all the year round may be mentioned—first, the Monas, the boundary between Kamroop and Gowalpara, which is very deep and rapid at the driest season as it enters the plains. The banks are 20 feet high in many places to the south. Boats cannot be taken up very far in the cold weather on account of bars formed by boulders of rock. Next, the Bor nuddee, the boundary between Kamroop and Durrung, which issues from the hills a deep powerful stream. It becomes shallower a little further down. Also the Jungrung, Chukrung, Rabung, and Deo Matee or Maree. The last-named encounters some white clay in its course before entering the plains; and, after a fall of rain, is milky in appearance, whence its name. All the lime procurable in the district comes from the bed of this stream.

The rivers which are lost for a portion of their course in the dry season, and reappear, are as follows:—The Shajung or Jhajunga: in the dry season, a short distance before the river issues from the hills, the water disappears; reappears a mile from the hills in a forest, and from that point flows throughout the year. The Tangun Maree: dry all dry season. The Takee nuddee: empty water-course in dry season as far south as Bheblabaree village, where water appears in the bed, and flows all the year round. The Teklye nuddee: no water where it first appears among the hills; but flows throughout the year in the plains. The Agrun nuddee: flows down to nearly four miles from the hills, where it disappears in dry season. The Simboo nuddee: no water in dry season in the slopes at foot of the hills. The Pohoomara: no water in dry season until five miles from the hills; but it is such a fine stream that boats of 500 maunds navigate it up to the Dooars. The Moro or Soroo Monas: as the foregoing. The Dijuma nuddee: water flows a very short distance into the plains in February, but reappears much further south. The Pugla

Deea, in Sobhunkhata village: water flows from the hills as far as Nilagee, about five or six miles, and disappears there in dry season; reappears at Oodla village, three or four miles further south, whence it flows in a good stream throughout the year into the Chawlkhawa. The Durrunga nuddee: in April, water was found half a mile into the hills, but the bed was dry a considerable distance to the south; after which the water breaks out, disappears once more, finally reappears and continues to flow. The Dowkobun Joolee: dry in February and March. The Matunga nuddee: water in the hills all the year round, but dry in the dry season for two miles after issuing from them, after which it reappears and flows in a steady stream. The Baldee nuddee: wet throughout the year about the hills; dry for some distance to the south in the dry months.

The following rivers have further peculiarities:—The Dirong nuddee, in Dihra village: in January water flows plentifully at night, and less during the day. In March, dry during the day, but flows at night. The Bor nuddee, in village Burya or Boira, flows in dry season from about 4 P. M. to about 4 A. M., near foot of the hills; a little further on, it becomes dry altogether. A nameless stream, east of the Seemajhora, flows from about 4 or 5 A. M. to about 7 or 8 A. M., and from 4 or 5 P. M., to 7 or 8 P. M.; or in the cool of the morning and of the evening; dry, rest of the day. This is from a point a quarter of a mile within the hills, up to which point the river runs continuously.

Remarkable trees.

4. In these Dooars are found the sassee tree, the inner bark of which, when prepared, is used to write upon, and resembles stout vellum, very white. Also the oodla tree, the bark of which makes excellent rope.

Wild beasts.

5. The Dooars swarm with animal life: tigers, bears, leopards, buffaloes, deer, pigs, &c. Along the forest strips skirting the hills, elephants, and towards the Monas, rhinoceroses.

Cultivation in the Dooars.

6. The cultivation in the southern parts is extensive, and consists, as in the rest of Kamroop, of paddy chiefly; also sugar-cane, mustard seed, and kullai. But further north paddy becomes a precarious crop on account of wild elephants. Last cold weather one village was simply abandoned because of the destruction they committed. The little cultivation there is to the north is chiefly mustard. Villagers living near the hills grow cotton on the slopes.

Paths into Bhootan.

7. The chief road to Dewangiri goes up to bed of the Durrunga nuddee. From Sobhunkhata there are two paths, one to the north-east, to Dewangiri, one north-west, to Oorungaon, a Bhootea town, residence of a Soobah. From Madla, a considerable Bhootea village, a path comes down the Agrun nuddee, which it first touches at the point of its junction with the Kyrong nuddee. Another path is along the Shajung nuddee.

Traffic with Bhootan.

8. The Bhooteas from Mudla bring down large herds to graze on the Agrun and Kyrong nuddees. They bring with them cotton, chillies, a red rock salt, rubber, bees' wax, yaks' tails, munjista (a red dye from a creeper), excellent radishes, and Indian corn. They take back with them paddy,

rice, and earthen pots. They carry their merchandise either on small donkeys or mules, or on their own backs.

At Soobhunkhata (whence two paths go into Bhootan) there is a large village, deserted during the rains, and occupied during the dry season by 2,000 or 3,000 trading Bhooteas, who come about January and leave about April. They bring with them gold, silver, lead, daws (knives) with straight blades two feet long, kookrees, blankets, dogs, ponies, mules, cows, yaks' tails, coarse cloths, chillies, precious stones, and, strange to say, pearls and mother o'pearl.

Inhabitants of the Dooars also visit the hills for trading purposes, and bring back with them chiefly rubber, honey, and frankincense.

The Bhooteas cultivate the slopes of their hills with cotton, a little paddy, and vegetables of many kinds, all growing promiscuously in the same field. They visit Hazoo and Gowhatty. Every year a large number travel to the former place, the temples of which have sacred associations for them as well as for the Hindoo.

The Southern Dooars.

9. The portion of the Dooars of South Kamroop which came under survey, and which includes Dooars Lookee, Bokoo, Bongaon, &c., is bounded on the south by the Cossyah hills, detached portions of which crop up here and there over the plain in bold masses of granite (gneiss) and basalt.

Road.

10. An imperial road, which is at present, however, only in an embryo state, and telegraph line pass through this tract, connecting Gowhatty with Gowalpara.

Rivers.

11. The chief streams are the Singra and the Bokoo, which both rise in the hills, apparently very close to each other. The latter flows directly north, and falls into the Doolsee; the former turns to the west, and, entering the district, flows parallel with the Bokoo, and falls into the Brahmapootra west of Nagarbera hill. The Bokoo receives no tributaries in its course through the country surveyed. The Geezang debouches from the hill south of Lookee Purbat, flows eastward, and falls into the Singra west of Hahim village. The Singra and Bokoo nuddees both flow all the year round, but are only navigable during the rains, when boats are taken up as far as the Geezang, to Hahim hât, to carry away the produce of the hills. The beds of these streams, which are broad as they issue from the hills, become half that width further north, as they pass through a hard clay soil. Hence, when after heavy rains, the rivers rise rapidly, the narrow channels are filled immediately and the country inundated.

Soil and Crops.

12. The northern portion of the Southern Dooars is low and marshy. The marshes extend further south in mouzahs Khareeja, Bokoo, and Dooar Bogaee. Dooar Lookee, and the south portions of Dooars Bokoo and Bongaon, are intersected by innumerable tortuous, sunken strips of land, called holas. These peculiar features of the country are about 10 or 15 feet below the general level, and vary up to 60, 100, or even 200 yards in width. Paddy is grown in these holas only and nowhere else. The soil in these low strips is a black clay with a slight admixture of sand.

Bekalee Moneah is thickly populated and very highly cultivated. The land is devoid of the peculiarity above referred to.

The highlands present the appearance of gently sloping hills, covered with short grass, with here and there a village and a grove of laka, mango, jack and betel-nut trees, beautifully picturesque. The soil is a stiff red clay; that on the hills to the south and east of the country under survey is the same, with a slight crust of vegetable mould.

Many portions of the hills surveyed are cultivated by the Garrows and produce remarkably fine crops of paddy, Indian corn, and rape seed, the last of a superior quality; also vegetables of many kinds, all sown indiscriminately at once and in one field, and each crop gathered as it becomes ripe. Towards the south of the country surveyed there are sâl forests.

Industry.

13. Lac in large quantities is produced from the laka tree, which is not easily distinguished from the ordinary peepul. There are two crops in the year, in November and May. The price on the spot is Rs. 8 to 12 per maund. The villagers usually receive advances from the mahajuns to cultivate it. It is sent to Calcutta.

In the dry season the natives dam up the hill streams for the purpose of irrigation, and also to catch fish, which they effect by poisoning the water. Konee-bees, bakral, ja-beree, beehoogalee and seejoo, which are all the pounded bark of trees, are used for this unpleasant purpose. The two first named can poison a wide extent of water, as far as fish are concerned. They are not considered injurious to man.

The inhabitants of the country included in this circuit are Cacharees chiefly.

The Garrows.

14. The Garrows, on the hills to the south, bring down lac, bees' wax, chillies, rubber, cotton, turmeric, ginger, potatoes, mooga, silk cocoons, Indian corn, and daws. The garrow, daws are very peculiarly shaped, somewhat like a Greek ç. They take back paddy, cows, salt, beads, &c.

Hâts.

15. The hâts in the Southern Dooars surveyed are—Boro Para, on bank of Bokoo nuddee, Saturday; Deej Bogace, near Demoolee nuddee, Wednesday; Shakmooree, Tuesday. Hakim hât, on the Singra, Tuesday; Joypore, Thursday, (Joypore is a police out-post); Nalapara (northern), near the Singra nuddee, Wednesday.

DESCRIPTION OF COUNTRY SURVEYED IN DISTRICT GOWALPARA, SEASON 1867-68, BY J. H. O'DONEL, ESQ., REVENUE SURVEYOR, 5TH DIVISION, LOWER PROVINCES.

Bengal Dooars divided into two districts.

On the annexation of the Bengal Dooars in January 1865, the country was divided into two districts called the West and East Dooars, the Sunkos river forming the boundary common to both. Mynagooree was selected as the civil station for the former, and Dutma for the latter. The revenue of the East Dooars was so small, that Dutma with all its new buildings was abandoned shortly after it was occupied, and the new district transferred to Gowalpara.

Country surveyed in 1867-68.

2. During season 1867-68 the remaining portion of the West Dooars between the Rydak and Sunkos rivers was surveyed. In the East Dooars, district Gowalpara,

Dooars Gooma, Repoo, Cheerung, and Sidlee have been surveyed. Dooar Bijnee only remains to complete the survey of the Bengal Dooars.

East Dooars.

3. The East Dooars district is situated at the base of the Bhootan hills, and extends from the Sunkos or Guddadhur river, which separates it from the West Dooars and Cooch Behar districts, on the west to the Monas river, and its old beds adjoining the Kamroop district of Assam on the east. On the south it is bounded by pergunnahs Ghoorla, Purbutjooar, and Khoontaghat of the Goalpara district. The approximate area is 1,558 square miles, of which about 350 square miles remain for survey.

Bidyagong and Bijnee estates.

4. The tract of country now known as the East Dooars was part of the Rangamatee district under the Mogul Government, and in 1785 formed two estates called Bidyagong and Bijnee of the Rungpore Collectorate; they were held by the rajahs of the same names, who, at that period, annually delivered elephants in lieu of money payments as revenue. The former forty, and the latter about the same number. Ninety years ago the country was as difficult of access and isolated as it is now. To evade payment of revenue, the Bijnee rajah told our officials that the Bijnee estate belonged to Bhootan, and to the Bhootan officials he represented it as British property. It is not surprising that some of our officials were misled, and described it as a vague debateable land. So little was then known of this part of the Bengal frontier, that in the first surveys of the last century both estates were confounded under the name of Bhootan Bijnee. When the last treaty with the Bhootan Government was negotiated in 1866, it was not then known that nearly half the Bengal Dooars in 1785 formed part of the Rungpore district, nor the manner in which the Deb rajah got possession of them. It is not likely the benevolent allowance of Rs. 50,000 per annum would have been so large. Much interesting information may be obtained of the early history of these estates from the old Rungpore records. The following extracts are taken from *Hamilton's East India Gazette*, vol. I, pages 242 and 275 :—

Bijnee.

"In consequence of their remote situation and general wildness of the country, the history of the estates in this quarter was long but imperfectly known even to the public functionaries at Rungpore; and so long as the Bijnee rajah paid the customary tribute, no enquiry was made as to the state of the country, or even to ascertain the original nature of its connection with the Mogul Emperor, to whose authority the British Government had succeeded. The notion so long prevalent, that the fort of Bijnee, with a considerable tract of the circumjacent country lies beyond the Bengal boundary was subsequently found to be quite erroneous, the Bijnee rajah having an evident interest in curtailing the extent of British influence."

Bidyagong.

"The line of frontier, east of the Sunkos to the confines of Assam, has been still more subject to the intrusions of the Bhootanners, as in this quarter they have managed to appropriate to themselves the large estate of Bidyagong immediately adjacent to Bijnee, where their interference, as will be seen under that head, was still more irregular. The Bidyagong estate was obliged originally to deliver annually 40 elephants to the British Government, which last, as the feudal superior, had the sole right of nominating to the

succession. It is true that the Bidyagong Chief gave the Bhootanners yearly about Rs. 400 worth of cotton, cloths, and dried fish; but this was done merely to conciliate the good will of a tribe, which from its position was always able to harrass his estate. The Bhootan Government never dared to dispute the sovereignty of the estate with the Moguls, from whom the delivery of the goods above, mentioned was kept a profound secret. The Deb rajah, while the attention of the British Presidency was directed elsewhere, got possession of the Bidyagong zemindary, and some years after, when the circumstances of the case were reported, it was determined to forego all claim to an object that appeared of such trivial importance."

Sub-divisions.

5. The East Dooars district is sub-divided into five Dooars called Gooma, Repoo, Cheerung, Sidlee, and Bijnee. Gooma was managed by the Soobah of Bara Dooar; the next Soobah was the Governor of Repoo. The jurisdiction of the Soobah of Cheerung extended eastward from Repoo to the Monas river, and included Dooars Cheerung, Sidlee, and Bijnee. The rajahs of Sidlee and Bijnee were amenable to his authority. The existing sub-divisions are now the same. Dooars Gooma, Repoo, and Cheerung are under khas management; the rajahs of Sidlee and Bijnee pay revenue as zemindars.

Bhootan boundary.

6. Thirty-one marks for platforms, for a distance of 85 miles, have been erected in laying down the remaining new Bhootan boundary from No. 47 on the Rydak river to No. 78 on the west bank of the Monas river adjoining the Kamroop district of Assam. The boundary runs along the foot of the hills from pillar to pillar, except from No. 49 to No. 50, where the western bank of the Sunkos river forms the boundary, and from No. 64 to No. 65, where the Dholapanee nuddee forms the boundary. The last mark, No. 78, is on the south-east corner of Bagh Dooa stockade, on the west bank of the Monas river. No person on the part of the Bhootan Government has ever been in attendance with the survey parties. Along the whole line of boundary the country is a desolate wilderness, impassable without first clearing a path. The villages of Begoo and Bishun Sing are now entirely deserted; two temples and the ruins of masonry buildings mark the site of Bishun Sing. Six maps will be prepared for the Public Works Department as a guide for ascertaining the position of the marks for platforms.

General appearance of the country.

7. The general appearance of the country is an undulating plain of high grass and reeds, with extensive forests of sâl and other trees, entangled with brush wood and creepers, rendering the country impassable. Wild animals are so numerous that the timber-cutters dare not venture in the forests except in large numbers. A few scattered villages are met with at distant intervals along the south on the borders of the Goalpara pergunnahs. On the north the country is totally uninhabited, and without water for miles. In January and February the grass jungle is burnt down; after the first showers in April the grass begins to grow fast, and is soon ten feet high. The unhealthiness of the climate is well known. Sickness prevails at all times, but chiefly in April and May, when few or none escape fever. Towards the south of Huldeebaree and Bhulka the lands are well cultivated, the numerous small streams afford facilities for irrigation.

8. The Bhootia map, bearing the seals of the Deb and Dhurm rajahs, dated 25th Falgoon 1230, or A. D. 1823, shows the limits of the lands held by Rajah Indronarain of Sidlee. On comparing boundaries, I find they are the same as the boundaries of the Bidyagong estate of the Rungpore district in 1785. The Aie river separated Bidyagong from Bijree. The Bhootan Government was in the habit of withdrawing villages from the jurisdiction of the Sidlee rajah, and placing them under direct management. When we took possession of the Dooars in January 1865, he was dispossessed of Dooars Gooma, Repoo, and Cheerung, west of the Aie river, and all the sâl forests. He paid the land rents of a few villages. It was at first supposed that Cheerung and Sidlee formed one and the same Dooar, but as progress was made with the survey, it was ascertained that the revenue of two talooks Janagaon and Deorgaon was collected by the Repoo tehsildar, and the revenue of talook Baotee, called also Nisma, was collected by Munsaroo Mundul of Baotee, son-in-law of Jemul, dewan of Cheerung. Two years before the last war, Joalia Mech obtained a sunnud from the Deb rajah to collect the tax for catching elephants, and the management of the timber mehals. He resided at Baotee, and likewise collected the land rents of the talooks named before, *viz.*, Janagaon, Deorgaon, and Baotee. He is said to have collected a force of about 600 men, chiefly from the North-Western Provinces. He burnt and plundered Bijnee and laid waste the country as far west as Huldebaree, where he was met by a force sent by the Dagor Penlow, and killed in the encounter. He has left no relatives except an infant daughter. On his death, the Sidlee rajah claimed Janagaon and Deorgaon, and the Bijnee rajah claimed Baotee. In May last Bateeram Mundul was appointed tehsildar of Cheerung. The exact limits of the lands held by Jaolia Mech to the north of Dooar Sidlee, chiefly unoccupied forests of trees and high grass, were never defined by the Bhootan Government. The boundaries of the three talooks were easily ascertained, but in the absence of any local information about the uninhabited forests called Noonmatee and Kachoobaree, &c., situated between them, or from the Longa or Hail nuddee on the west to the Aie nuddee on the east, a new line of the boundary has been laid down by me, separating the limits of villages in the possession of the Sidlee rajah from Cheerung. He claims these lands likewise, but owing to the death of Jaolia Mech, the khas manager under the Bhootan Government, there is no one to dispute his claim. As the country is now better known, the interests of Government will, no doubt, receive the early attention of the Deputy Commissioner. After excluding the Dooars, of which the rajah was dispossessed by the Deb rajah, and the sâl forests on the Gowrang nuddee reserved for the Forest Department, he has the rest of Sidlee Dooar, an extensive fertile tract containing 190,521 acres, or 298 square miles, for which he now pays only Rs. 506. The present rate of assessment on the cultivated area of 18,307 acres is 5 pie per acre, and on the total area four-tenths of a pie.

Cheerung and Sidlee Dooars.

9. Roads, properly speaking, there are none. During the last war a road was opened out from Aleepore to Raha thannah in Kamroop, passing east and west across the newly annexed country. It is now in most places overgrown with high grass,

Roads.

and being intersected by numerous deep streams, which have swept away the wooden bridges, it is not passable for laden cattle, except elephants, and even for elephants with great difficulty. From its neglected state in the West Dooars, it is evidently not considered of any importance even for administrative purposes, and in the East Dooars it has been entirely abandoned. All the police stations in the Dooars, from Aleepore eastwards, are situated on this route. The distances of police stations from Aleepore to Raha thannah are noted below :—

From Aleepore to Huldeebaree	...	21 Miles.
„ to Raimana	...	29 „
„ to Dutma	...	46 „
„ to Sidlee	...	67 „
„ to Bijnee	...	85 „
„ to Raha thannah	...	94 „

It took me six days to march from Aleepore to Huldeebaree, 21 miles, the high grass had to be cleared, and the road sloped in many places. The nullahs with deep puddles and water were crossed by heaping up bundles of grass as a footing for animals. I found it impossible to proceed beyond Huldeebaree to Dutma before the road was first cleared.

Rivers.

10. The principal rivers which flow from the Bhootan hills and fall into the Brahmapootra river, are the Sunkos or Guddadhur, the Saralbhanga or Gowrang, the Chumpamotee and the Aie.

Sunkos river No. 1.

The Sunkos river enters the Dooars seven miles north of Huldeebaree police station. It is deep and nowhere fordable, and flows over a stony bed with a strong current. Rapids are numerous, and navigation, except for very small boats, becomes precarious above Lowkootee or Bukseegunj, a large mart for country produce in Kooch-Behar. Below Bhulka it is called Guddadhur, and three miles below Simlabaree hât the name changes to Gungadhur. It is crossed by ferries at Huldeebaree, Bhulka, Lowkootee and Sogoonchara. The Guddadhur formerly flowed from Simlabaree into the Brahmapootra at Dhoobree, the old bed is still navigable for small boats to Purtabgunj hât.

Rydak and Sunkos river No. 2.

The Sunkos river changed its course some years ago and flowed into the Guddadhur, leaving its old bed dry and difficult to trace in places. The Rydak river now flows into the western Sunkos near the village of Pokalagee, it is called Sunkos from thence to its junction with the Brahmapootra river. Tracing these two rivers from the hills to the Brahmapootra, the Sunkos, Guddadhur, and Gungadhur are now one continuous stream. The Rydak and Western Sunkos is another distinct stream. Both these rivers, after keeping six to eight miles apart, flow into the Brahmapootra near Pooteemaree hât.

Saralbhanga or Gowrang river.

The Saralbhanga river leaves the hills four miles south of Bishunsing near Pokeehagee encamping ground, so called after the name of a large rock in its bed. It is almost a bed of stones and sand, dry in some places where it flows underground, and with a narrow channel of water in others. Near the village of Patgaon it begins to flow again till it joins the Gowrang nuddee. The Gowrang nuddee rises from the sâl forests west of Bidyagong; it is a small stream till it receives the water of the Sowmoka and Saralbhanga near Chundurpara

Lower down, the united stream is called Gowrang till it flows into the Brahmapootra near Belaseepara. It admits of small boats as far as Chundurpara, where it is crossed by a ferry.

Chumpamotee river.

The Chumpamotee river rises in the forests of Cheerung Dooar. It receives the waters of the Dholapanee and Lapanee on the west, and the waters of the Borobhoor on the east. The bed becomes deeper as it enters alluvial soil; it is crossed by a ferry at Batagaon, and lower down at Dhuntola, where it leaves the Dooars. At Dhuntola it admits of boats of 50 maunds, and smaller boats higher up to Batagaon.

Aie river.

The Aie river enters Cheerung Dooar near Madaljhar and flows with a strong current over a bed of stones. In the upper part of its course there are several beds, some with water, and others quite dry. It receives the waters of the Boaree Aie near Deburgaon, and of the Kanamakra near Goonburgaon where it becomes deeper, but does not admit of boats of more than 20 or 30 maunds from thence to its junction with the Monas river. It is deep in many places and is crossed by a ferry at Balatol ghât on the road from Sidlee to Bijnee.

Goroopala and Sunkos river No. 3. Nokooldanga ghât.

The Goroopala nuddee rises in the forests north of Raimana police station; it flows in a serpentine course to Rajadabree, where there is a timber depôt of logs of sâl from the Repoo sâl forests. There was formerly in 1852 a timber customs ghât at Nokooldanga, at the junction of the Goroopala and Gongea nuddees, four miles south-west of Dutma, where the zemindars of Purbutjooar and Khoontaghat, and the rajah of Sidlee levied tolls. The Longa nuddee falls into the Goroopala half a mile lower down, where the name of the united stream is changed to Sunkos, and it retains that name till it falls into the Brahmapootra near Bogreebaree.

Mileage of water communications.

11. Large boats are seen at Lowkootee on the Guddadhur river. The ferry boats are the only ones generally met with on the other rivers, which are useful for floating down sâl timber from the forests during the rains. There is water communication for large boats on the Guddadhur river for six miles from Sepai hât to Lowkootee, and from thence for small boats to Huldeebaree, 29 miles. On the Goroopala for small boats of 20 maunds for 16 miles from Nokooldanga ghât to Rajadabree. On the Gowrang and Saralbhanga for 16 miles from Chundurpara to Patgaon. On the Chumpamotee for 18 miles from Dhuntola to Batagaon. On the Aie 21 miles from the Monas to Goonburgaon. The mileage of water communication for large boats is six miles, and for small boats of about 20 maunds, 100 miles.

Towns and large villages.

12. There are no towns or large villages of note. Dutma, once the civil station of East Dooars, is now only a police station. It is surrounded on all sides by high grass jungle. Nothing now remains of the many bungalows erected in 1865, except a few charred posts. The rajahs of Sidlee formerly resided at Bidyagong at the junction of the Borobhoor and Chumpamotee nuddees. No trace is now left of the old site. They removed some years ago to the village of Nonnagaon called Sidlee, where the rajbaree is situated. The fort of Sidlee captured by Dheer Narain in 1837 is the same site as the present

rajbaree. It has a ditch three hands deep and five hands wide on the south side, and on the other sides a fence of reeds and grass like the usual enclosures round the huts of each ryot. There is a police station at Sidlee where the rajah's family and a few retainers reside.

Ruins.

13. The ruins of two sun-dried brick buildings have been laid down in the village of Chengmaree near Huldeebaree called Boro and Chota Hem Rajbaree, they were intended as a temporary residence for the Deb rajah when he visited the Dooars, which from enquiry it appears he never did.

Population.

14. The total number of inhabitants within the portion of the West Dooars district surveyed in 1867-68 is 2,815 or 25 to the square mile, they are detailed below :—

Rajbungsees	2,616
Mech	52
Garrows	70
Mahomedans	77
	2,815

The total number of inhabitants within the surveyed portion of the East Dooars is 8,193 or less than 7 to the square mile, they are detailed below :—

Hindoos or Rajbungsees	1,756
Mahomedans	158
Mech	6,054
Garrows	215
Bhootias	10
	8,193

Revenue, East Dooars.

15. The annexed table exhibits the items of revenue for the year 1867-68 :—

Names of Dooars.	Land Revenue.	Forests.	Miscellaneous.	Total.
Gooma	484 0 0	485 2 8	.....	969 2 8
Repoo	1,002 8 0	577 0 0	470 0 0	2,049 8 0
Cheerung	431 2 0	5,055 10 0	220 0 0	5,706 12 0
Sidlee	506 7 0	.....	.....	506 7 0
Bijnee	432 0 0	.....	120 0 0	552 0 0
	2,856 1 0	6,117 12 8	810 0 0	9,783 13 8

There are no local land measures ; land for rice and other crops pays generally Rs. 2 per plough, and in Sidlee Rs. 7½ Narainee per plough. Cotton and mustard seed cultivated in the jungles pay Rs. 1-4 per kodal. Licenses for catching elephants are granted at the rate of Rs. 20 for each koonkee. The country is isolated, and so little known that there are no grants of waste land.

16. Trade with Bhootan is nominal. Bees' wax and blankets are bartered for tobacco and English cloths. The few inhabitants manufacture cloths for their own use.

Trade.

17. There is a hât at Dingdinga in Gooma. At Dutma there are two modees' shops and a temporary hât in the cold weather. Supplies of rice and other articles of food were obtained from the villages in pergunnah Khoontaghat, and distributed to parties. Thirty maunds of rice could not be purchased at Dutma without objections being raised that so large a quantity could not be conveniently spared for sale.

Supplies.

18. The sâl forest to the south of Huldeebaree police station has been separately marked for the forest department. It is called Salbaree-Dooar, Buxa, and is situated on the Sunkos river. The area is 8,413 acres, of which 34 acres are cultivated. Seventy Garrows reside within this forest.

Sâl forests District West Dooars.

19. The next block marked is No. 11 Salbaree, Dooar Gooma, situated west of the Purbutjooar sâl forest. The area is 15,779 acres, of which 200 acres are cultivated, and the number of inhabitants is 215. The revenue paid annually is Rs. 485, an amount equivalent to the land revenue of Dooar Gooma. In Dooar Repoo, Nos. 23 and 24, Notogaonjhar and Kochoogaonjhar, containing an area of 34,403 acres, have been reserved for the forest department. This block is situated between the Langa or Jakatee nuddee on the west, and the Polo nuddee on the east, and the new Bhootan boundary on the north. It is uninhabited. The northern limits were at one time disputed, but since the boundary has been laid down the Bhootias are satisfied. The revenue received is Rs. 577.

Sâl forests District East Dooars, Goalpara.

In Dooar Cheerung, Nos. 32 and 33, Janagaon and Janagaon Salbaree, containing an area of 37,220 acres have been marked. This block is a continuation eastward of the Repoo sâl forest, and extends to the Longa or Hail nuddee. It is uninhabited. The revenue is Rs. 5,055.

The next block is known as the Gowrang sâl forest in Dooar Sidlee. It extends from the Sowmoka nuddee on the west, to the Chumpamotee nuddee on the east. It contains an area of 40,274 acres, of which 511 acres are cultivated, and the number of inhabitants is 145. For survey purposes it was divided into 11 blocks, Nos. 59, 62 and 69 to 77 and portions of Nos. 63, 64, and 68. At present there is no forest revenue paid. The area and revenue paid for the sâl forests is detailed below :—

						Area.	Revenue.
District	West Dooars—	Dooar	Buxa—	Salbaree	... Acres	8,413	None.
Do.	East Dooars	do.	Gooma	do.	... „	15,779	Rs. 485
Do.	do.	do.	Repoo	do.	... „	34,403	„ 577
Do.	do.	do.	Cheerung	do.	... „	37,220	„ 5,056
Do.	do.	do.	Sidlee	do.	... „	40,274	„ None.
					Total „	136,089	Rs. 6,118

The cultivation within the sâl forests is constantly changed, and in the new clearings numbers of trees are cut down and burnt. It would be an advantage to pay compensation to the few cultivators, and remove them to other places where there is waste land in abundance. Some of them may prove useful as laborers for forest work. The timber-cutters

pay from Rs. 4 to 5 for each koral or axe, besides jhar salamee to each duffadar. A pair of sâl logs six or seven feet long and four feet round sells for Rs. 8. The trees used for making canoes are sâl, chuma, goonsuraie, and chumpa.

Productive resources.

20. Till communications are opened out, and this isolated district made easy of access, and settlers encouraged, the revenue is not likely to improve much. The magnificent sâl forests now pay Rs. 6,118, more than double the land revenue. The extensive fertile tracts now overgrown with grass and reeds require settlers. A population of less than seven to the square mile cannot increase the limits of cultivation. If the country is neglected and left to itself, it may in a century be gradually cultivated like the neighbouring district of Kooch-Behar. The knowledge of its resources, obtained from the maps and other statements furnished by the Revenue Survey, showing its cultivated area, forests, and other lands now waste and unproductive, will be of much value in the hands of a Settlement Officer. Roads and settlers are required. No settlement has yet been made; the land rents paid to the Bhootan Government have been roughly ascertained, and the amount annually collected.

DESCRIPTION OF COUNTRY SURVEYED IN DISTRICT LOHARDUGGA, SEASON 1867-168, BY CAPTAIN J. SCONCE, REVENUE SURVEYOR, 6TH DIVISION, LOWER PROVINCES.

The larger portion of main circuit No. 7 consists of *Tuppeh Burkol*, an estate which lapsed to Government about the year 1856, failing an heir to the last proprietor, and which was bestowed on *Rai Kishundeeul Singh*, a large proprietor in the *pergunnah* who resides at *Runka*, for his good services during the disturbances of 1857. The villages show traces of having been formerly more populous and having had more land under cultivation than at present, and this is said to be the result of the high rents demanded by the present owner. It does not appear that any arrangement was made regarding the villagers' rights at the time of transfer.

The low scarped plateau where the deserted site of *Doothoo* is shown, the credited haunt of a demon by the readily superstitious belief of the people of this wild district, gives its name to a large Tuppeh of 63 villages, which are chiefly owned by a large proprietor residing at *Chainpoor*.

The small Tuppeh of *Chetkee* is part of the estate of *Rai Kishundeeul Singh* of *Runka*, who is mentioned above.

To the south of this main circuit, the *Goolgoolpat* plateau, a bold feature, is a comparatively narrow off-shoot from an extensive high plateau to the south-east. The height has been deduced from *Turer* G. T. S. 3,814 feet.

Bijka is another hill of great prominence, especially from the north, height 2,479 feet. The *Nowka* and *Megonee* hills are also well-marked features.

In the south of the circuit, there is a well cultivated plain with a considerable extent of terraced rice land. The villages *Pursowar*, *Burkol*

Khoord, and *Burgurh* are on the most flourishing. At *Burgurh* there is a police out-post. To the north of the circuit, about the villages *Junnewa* and *Dhusnee*, there is a considerable extent of good culturable land, at present covered with a sparse jungle. The *Kunhur* river has low banks and is everywhere fordable during the dry season.

Two routes of communication from the *Sirgoojah* State pass through this circuit towards *Daltongunge* and *Gurwa*, and during the cold weather months there is a considerable traffic by pad bullocks.

There are no made roads, and carts are unknown in this part of the *pergunnah*.

Description of country in Main Circuit No. 8.

Main Circuit No. 8 includes the whole of tuppeh *Khuppurmunda* with the exception of two villages which have been surveyed in Main Circuit No. 9. *Khuppurmunda*, part of the estate of *Rai Kishundeeul Singh* of *Runka*, is considered one of the wildest parts of Palamow, and from the small number of inhabitants and large extent of land lying waste it well deserves the character.

The eastern portion of the *tuppeh* is very high land, but much intersected by streams and broken into ravines.

The western portion of the *tuppeh* towards the *Kunhur* river is low, the land is however poor.

The fall from the high land is very abrupt to the south of the circuit, but in the north, in which direction the drainage of the high land chiefly escapes, the fall is very gradual.

The best villages are towards the south—*Bhowree*, *Burduree*, *Bandoo*, and *Chutroo*, where the country is fairly open with a considerable amount of cultivation.

The huts in the villages are all of the poorest description. Towards the south, the *Kunhur* river has a low rocky bed, but in the north, opposite to the villages *Khooree* and *Chumkullee*, the bed is much below the general level of the country, and the banks are precipitous.

Description of country in Main Circuit No. 9.

Tuppeh Kutree, of which 20 villages are surveyed in the southern sub-division of Main Circuit No. 9, is part of the estate of *Rai Kishundeeul Singh* of *Runka*; the remaining villages were surveyed in Main Circuit No. 6 of season 1865-66.

Tuppehs *Meeral*, *Bunka*, *Umhur*, *Koorga*, and *Oontaree* are held either as the direct estate of *Bhai Bhugwan Deo Nugur Oontaree*, or are held in sub-tenure from him.

The southern villages of the circuit compose part of the high *Khuppurmunda plateau*, the ascent to which from the low villages of *Kutree* is high and abrupt in the east, gradually becoming lower until the *ghat* entirely disappears in the village of *Kethma*.

In Tuppeh *Kutree* the upland crops are chiefly grown, but little terraced lands for rice being met with.

In tuppehs *Meeral*, *Bunka*, *Umhur*, and *Koorga*, there are several flourishing villages, and a considerable extent of terraced rice land. This wet cultivation is gradually extending; the returns from the expense of terracing apparently being rapid and certain; the entire outlay is said to be recovered after from four to ten years, according to the situation of the terraced lands.

The northern villages of tuppeh *Umkur* streten on to a nigh plateau on the boundry of the *Gya* district. This high land is an abrupt and prominent feature above the low valley of the *Bankee nuddee.*

The better villages in the northern portion of the Main Circuit are *Meeral* and *Bishunpoora,* (where there are weekly markets) and *Silleedag.* A small weekly market has also been recently established at *Bugondha.*

A cart road might easily be made from *Gurwa,* about five miles east of *Khujooree,* through *Meeral* to *Bishunpoora* and on to *Oontaree* about ten miles further west, which would open up the fertile valley of the *Bankee nuddee,* and which might be carried on to *Doodhee* in the *Mirzapore* district, from which there is a cart road to *Mirzapore.*

At present there are no made roads.

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